# Prevalence and Risk Indicators for Attachment Loss in an Urban Population of South India

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## Abstract

**Aim:** To estimate the prevalence and severity of attachment loss in an urban population of South India and to determine related risk indicators.

**Materials and Methods:** This population based cross sectional study used a subset of data from a large survey representative of urban population from Chennai city. The sample consisted of 900 subjects in the age range of 17years to 87 years. Participants were interviewed using a structured proforma and subjected to a full mouth clinical examination of six sites per tooth. The prevalence of clinical attachment level (CAL) and association with various risk indicators was assessed.

**Results:** Out of the 900 subjects examined, 868 (96.4%) had CAL <5 mm and 32 (3.6%) had CAL ≥ 5 mm. Age, smoking, poor oral hygiene were found to be independent risk indicators for CAL ($p<0.05$). Smoking (pack years) was found to exhibit a dose response effect with CAL (Kendall's Tau coefficient = 0.098) ($p<0.05$).

**Conclusion:** In this urban population, a low prevalence of CAL ≥ 5 mm was observed. Amongst the risk indicators evaluated, age, smoking and poor oral hygiene contribute significantly to attachment loss.

*Key Words: Cross-Sectional Study, Periodontal Attachment Loss, Risk, Urban Population*

## Introduction

Chronic periodontitis is an inflammatory disease of microbial etiology that affects the tooth supporting structures. The microbial challenge posed by periodontopathic bacteria in the subgingival biofilm kindles the host immune response. This leads to the production of an array of cytokines and other inflammatory mediators which cause tissue damage resulting in pocket formation, tooth mobility and attachment loss. Clinical Attachment Level (CAL) represents one of the important clinical parameters which provide an indication of the degree of remaining tooth support. The etiology of attachment loss can be broadly subdivided as plaque induced and non plaque induced [1]. Attachment loss can be attributed to accumulation of plaque/calculus, habits such as smoking, faulty brushing technique, and iatrogenic causes [2]. Evidence in literature exists wherein varied risk indicators have been correlated with the prevalence and severity of CAL [2-5]. Methodological variations limit the interpretation and analysis of epidemiologic data as there is difference in the number of teeth examined for CAL [6]. Full mouth assessment of CAL represents a valid method for determining the overall periodontal status of a subject. The aim of this study was to estimate the prevalence and severity of attachment loss in an urban population of South India and to determine related risk indicators.

## Materials and Methods

### Study design

This study was designed as a cross-sectional survey. The target population was subjects aged 17 years and above living in the metropolitan area of Chennai, in the state of Tamil Nadu, southern part of India. The study was approved by the Institutional Ethics Committee, Sri Ramachandra University.

### Sample size calculation

There was lack of data regarding the prevalence of CAL in the target population and so a prevalence rate of 50% along with a precision ± 5%, 99% confidence level was assumed for calculating the study sample. The minimum required sample size was 664 subjects.

### Sampling method

The subjects recruited for this study were a subset of a larger sample originally recruited for the Population study of Urban Rural and Semi urban regions for the detection of Endovascular disease and prevalence of risk factors and Holistic Intervention Study (PURSE-HIS) study. Briefly, for the PURSE-HIS study, 2160 subjects from urban population were selected by two-stage cluster sampling method. In the urban setting, the primary sampling unit was that of divisions of Chennai Corporation. 9 out of 155 divisions were selected and at the second stage the required numbers of clusters (streets) were selected by simple random sampling. If the selected cluster was small, immediate neighbouring area of the selected cluster was considered till the desired sample size was achieved.

### Operational procedure

Out of the 2160 urban subjects participating in the PURSE-HIS study, 990 subjects gave a verbal informed consent to undergo a dental examination. These subjects were examined by two trained periodontists, calibrated for inter examiner variability. 40 out of the 990 subjects were examined independently by both periodontists. Inter examiner variability for CAL assessment was determined and the weighted Kappa index was 0.92. Exclusion criteria were pregnancy, lactating mothers, completely edentulous individuals and individuals requiring antibiotic coverage for routine periodontal examination.

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### Proforma

Subjects who consented to participate were interviewed to gather self reported data regarding demographic, socioeconomic status, dental, medical history and other systemic diseases using a structured proforma. Systemic diseases included diabetes mellitus, hypertension, and gastrointestinal disorders. Assessment was done in a dichotomous manner as presence or absence of the condition. Monthly income was classified as high (more than or equal to Rs.10000/month), middle (Rs.5000–Rs.10000/month), low (Rs.1000 – Rs.4000/month). In addition smoking status was evaluated (current, former, never). Current and former smokers were classified based on criteria established by Centers for Disease Control and Prevention (CDC) [7]. "Current smokers" were defined as those who have smoked 100 or more cigarettes over their life time and currently smoking at the time of interview; "former smokers" who had smoked 100 or more cigarettes in their life time but were not currently smoking. Pack years were calculated and recorded by multiplying number of cigarettes smoked per day and number of years, alcohol consumption (non drinkers, drinkers), tobacco chewing (non chewers, chewers), and oral hygiene habits. Oral hygiene habits were assessed in a dichotomous manner (yes/no) under the following categories: Oral hygiene aid used (toothbrush, finger, indigenous), dentrifice (toothpaste, tooth powder, indigenous), tooth brushing technique (scrub technique, vertical technique, other), frequency of tooth brushing (once daily, twice daily, more), use of inter-dental devices (floss, inter-dental brush, tooth pick) and frequency of professional oral hygiene sessions (once a year or more). The subjects were categorized, based on the diet as vegetarians (those who consume vegetables, milk and do not consume egg or meat), mixed diet (those who consume vegetables, milk, egg and meat). First dental visit was attributed to those subjects who had never visited the dentist prior to participation in this study for any dental problems/ treatment.

### Clinical examination

Each clinical examination required an average of 45 minutes. No radiographic examination was carried out. All permanent fully erupted teeth excluding the third molars were examined. The oral hygiene status of the subjects was assessed by means of Oral Hygiene Index Simplified (OHI-S) [8]. The oral hygiene status was categorized as Good (score 0 – score 1.2), Fair (score 1.3 - score 3) and Poor (score 3.1 - score 6). The status of the subject's dentition was recorded using Decayed Missing Filled Teeth (DMFT) index [9] that indicates the number of teeth that are decayed, missing due to dental caries, or filled as a result of caries. Clinical Attachment Level (CAL) was measured at six sites per tooth (mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual, distolingual) using a UNC15 periodontal probe. Measurements were rounded off to the nearest millimeter. CAL was measured in cases of exposure of Cemento-enamel Junction (CEJ) by the distance from CEJ to base of the gingival sulcus. The level of CEJ was determined by tactile perception with the tip of the periodontal probe.

### Stratification of subjects based on CAL

The mean CAL was computed over all the six sites examined per tooth for each subject. The subjects were stratified [10] into two groups based on mean CAL as [a] CAL <5mm and [b] CAL ≥ 5 mm.

## Data Analysis

The data on clinical, socio-demographic, systemic diseases and habits were entered to a computer database specifically prepared for this study. Mean and frequency distribution for the continuous variables in the study population were calculated. Data analysis was done with mean CAL as the dependent variable. The association between mean CAL and risk indicators was assessed by bivariate analysis (Pearson's chi square test). Those indicators which showed a significant association were subjected to multivariate logistic regression analysis (Wald statistic model). Kendall's Tau correlation analysis was done to determine dose response effect of smoking (pack years) with mean CAL. A p-value < 0.05 was considered statistically significant. Data was analyzed using software SPSS for windows (version 16).

## Results

The outcome variable of interest in this study was Clinical Attachment Level (CAL). The total study sample included 900 subjects of whom 479 (53.2%) were males and 421 (46.8%) were females. The descriptive data of the study population are summarized in *Table 1*. Out of the 900 subjects examined 868 (96.4%) had CAL <5mm and 32 (3.6%) had CAL ≥ 5 mm. Stratification of the study population based on age and gender are summarized in *Table 2*.

A bivariate logistic regression analysis was done to assess the association of various risk indicators with mean CAL as dependent variable (*Table 3*). Age, hypertension, diabetes mellitus type II, first dental visit, tobacco smoking, horizontal brushing technique (scrub method) and oral hygiene status of the individual showed a statistically significant association with CAL (p value <0.05). The above mentioned risk indicators were included for a multivariate logistic regression analyses (*Table 4*). The following risk indicators; age, tobacco smoking, poor oral hygiene status demonstrated a statistically significant association with CAL >5 mm (p <0.05). Smokers were found to have 2.6 times greater risk to develop CAL > 5 mm as compared to non smokers (p=0.029). A correlation analysis between pack years and mean CAL was performed and a positive correlation was observed. For every one year increase in pack year; 0.098mm increase in CAL was found. (Kendall's tau correlation coefficient=0.098, p=0.002).

## Discussion

This study was undertaken to assess the prevalence of CAL in a sample of urban population of South India. In addition, the association of various risk indicators with CAL was also evaluated. A major segment of the study population had CAL <5mm (96.4%). The observation of severe CAL in our study was lower than previously reported data in American, European and Asian populations. Rheu et al. [3] evaluated the prevalence and extent of mean CAL in 2519 urban Korean adults aged ≥ 40 years and reported mean CAL prevalence in different degrees of severity as <1mm,1-3mm, 3-5mm and >5 mm. The observations of Rheu et al. [3] revealed <1% of the study subjects had CAL >5mm. A similar study by Bouchard et al. [10] in French subjects aged 35-60 years reported 19.7% prevalence of CAL >5mm and 80.3% prevalence of CAL<5mm. Dye et al. [11] conducted a study to evaluate the trends in oral health in U.S.A and the authors reported that CAL ≥ 3 mm occurred in 32.7% of the subjects and CAL ≥ 5 mm was reported in 9.2% of the subjects. The above mentioned studies provide an insight into the varied prevalence of CAL in different populations worldwide. There appears to be considerable difference in CAL prevalence between populations in various geographic regions which could be attributed

***Table 1.*** *Descriptive data of the study population.*

| Variable | | Frequency (%) |
|---|---|---|
| n=900 | | |
| Age | <20 years | 20 (2.2)* |
| | 21-40 years | 386 (42.9) |
| | 41-60 years | 430 (47.8) |
| | >60 years | 64 (7.1) |
| Gender | Males | 479 (53.2) |
| | Females | 421 (46.8) |
| Diet | Vegetarian | 66 (7.3) |
| | Mixed diet | 834 (92.7) |
| Systemic disorders | Hypertension | 150 (16.7) |
| | Diabetes type II | 153 (17) |
| | Gastro-intestinal disorders | 80 (8.9) |
| | Respiratory disorders | 40 (4.4) |
| | No disorders | 477 (53) |
| Habits | Smoking | 137 (15.2) |
| | Tobacco chewing | 41 (4.6) |
| | Alcohol | 190 (21.1) |
| | Pan chewing | 53 (5.9) |
| | No habit | 479 (53.2) |
| Oral hygiene aid | Toothbrush | 872 (96.9) |
| | Other | 28 (3.1) |
| Toothbrushing technique | Vertical method | 108 (12) |
| | Scrub Method | 612 (68) |
| | Other | 180 (20) |
| Oral hygiene status [OHI(S)] | Good | 104 (11.6) |
| | Fair | 515 (57.2) |
| | Poor | 281 (31.2) |
| DMFT (Mean ± SD) | 5.03 ± 4.38 | |
| Probing Pocket Depth (Mean±SD) | 4.35 ± 2.16 | |

Data presented as a number (%), * Percentages are based on a total of 900 subjects

***Table 2.*** *Subjects stratified based on age and gender.*

| Variable | | CAL <5 mm n(%)* | CAL ≥ 5 mm n(%)* | Total n(%)* |
|---|---|---|---|---|
| Age | < 20 years | 20(100) | 0(0) | 20(100) |
| | 21 – 40 years | 386(100) | 0(0) | 386(100) |
| | 41- 60 years | 402(93.5) | 28(6.5) | 430(100) |
| | >60 years | 60(93.7) | 4(6.3) | 64(100) |
| Gender | Male | 458(95.6) | 21(4.4) | 479(100) |
| | Female | 410(97.4) | 11(2.6) | 421(100) |

*Percentages are based on number of individuals within each group

to socioeconomic conditions, habits, and cultural traits of the target population.

To the best of our knowledge this is the first study to have estimated the CAL prevalence in a South Indian urban population. A low prevalence of CAL ≥ 5 mm (3.6%) was observed however, this does not correspond to lower prevalence of periodontitis in this study population as the mean probing depth was 4.35 ± 2.16 mm.

Among the risk indicators evaluated; age, hypertension, diabetes mellitus, first dental visit, smoking, poor oral hygiene, toothbrushing technique demonstrated a statistically significant association with mean CAL in the bivariate analytical model. However, in the multivariate analytical model, well known factors; age, smoking and poor oral hygiene proved to be independent risk indicators for CAL. A number of studies have reported an increase in prevalence of CAL with increasing age [2-4]. The result of this study reveals an increase in prevalence and severity of CAL up to 60 years of age and a decline thereafter. This observation could be attributed to lesser number of subjects in > 60 years age group (64/900 subjects). With respect to gender, greater proportion of males had a higher mean CAL > 5mm (4.4%) as compared to females (2.6%). This could be due to more number of males having poor oral hygiene, less positive attitudes towards oral health and dental visit behaviors seen among males than to any genetic factor [5].

Subjects with hypertension (presence/absence, self reported) had 1.4 times higher risk of CAL >5mm compared to non hypertensive subjects. This observation is in accordance with the results obtained by Khader et al. [2] and Wakai et al. [12]. In connection with diabetes mellitus (presence/absence, self reported), diabetics had a higher

***Table 3.*** *Association between risk indicators and mean CAL (Bi-variate analysis).*

| Variables | | CAL <5mm n(%) | CAL ≥5mm n(%) | Total n(%) | p value |
|---|---|---|---|---|---|
| Age | < 20 | 20(100) | 0(0) | 20(2.2) | 0.000* |
| | 21 – 40 | 386(100) | 0(0) | 386(42.9) | |
| | 41- 60 | 402(93.5) | 28(6.5) | 430(47.8) | |
| | >60 | 60(93.7) | 4(6.3) | 64(7.1) | |
| Gender | Male | 458(95.6) | 21(4.4) | 479(53.2) | 0.152 |
| | Female | 410(97.4) | 11(2.6) | 421(46.8) | |
| Hypertension | Yes | 139(92.7) | 11(7.3) | 150(16.7) | 0.006* |
| | No | 729(97.2) | 21(2.8) | 750(83.3) | |
| Diabetes Mellitus | Yes | 143(93.5) | 10(6.5) | 153(17) | 0.029* |
| | No | 725(97.1) | 22(2.9) | 747(83) | |
| First Dental Visit | Yes | 250(98.4) | 4(1.6) | 254(28.2) | 0.044* |
| | No | 618(95.7) | 28(4.3) | 646(71.8) | |
| Vegetarian | Yes | 61(92.4) | 5(7.6) | 66(7.3) | 0.067 |
| | No | 807(96.8) | 27(3.2) | 834(92.7) | |
| Smoking | Yes | 128(93.4) | 9(6.6) | 137(15.2) | 0.039* |
| | No | 740(97) | 23(3) | 763(84.8) | |
| Tobacco chewing | Yes | 39(95.1) | 2(4.9) | 41(4.6) | 0.640 |
| | No | 829(96.5) | 30(3.5) | 859(95.4) | |
| Alcohol | Yes | 184(96.8) | 6(3.2) | 190(21.1) | 0.739 |
| | No | 684(96.3) | 26(3.7) | 710(78.9) | |
| Toothbrush | Yes | 842(96.6) | 30(3.4) | 872(96.9) | 0.298 |
| | No | 26(92.9) | 2(7.1) | 28(3.1) | |
| OHI(S) | Good | 103(99) | 1(1) | 104(11.6) | 0.000* |
| | Fair | 504(97.9) | 11(2.1) | 515(57.2) | |
| | Poor | 261(92.9) | 20(7.1) | 281(31.2) | |
| Scrub Technique | Yes | 596(97.4) | 16(2.6) | 612(68) | 0.026* |
| | No | 272(94.4) | 16(5.6) | 288(32) | |

* p<0.05

***Table 4.*** *Association between risk indicators and mean CAL (dependent variable) (Multivariate analysis).*

| Variable | Odds Ratio | 95% C.I | | p value |
|---|---|---|---|---|
| | | Lower | Upper | |
| Age* | 0.378 | 0.199 | 0.720 | 0.003** |
| Hypertension† | 1.390 | 0.592 | 3.265 | 0.450 |
| Diabetes Mellitus‡ | 1.503 | 0.637 | 3.549 | 0.353 |
| First dental visit§ | 0.342 | 0.114 | 1.032 | 0.057 |
| Smoking‖ | 2.587 | 1.101 | 6.078 | 0.029** |
| Scrub brushing technique¶ | 0.638 | 0.231 | 1.759 | 0.385 |
| Poor Oral Hygiene OHI(S)# | 0.363 | 0.180 | 0.732 | 0.005** |

** p<0.05
*Reference category = <20 years of age
† Reference category = No hypertension
‡ Reference category = No Diabetes
§ Reference category = Previous dental visit for treatment.
‖ Reference category = No smoking.
¶ Reference category = other brushing techniques
# Reference category = Good Oral Hygiene [OHI(S)]

mean CAL as compared to non diabetics. This is in accordance with previous investigations [13-17]. There are also some conflicting reports in literature correlating diabetes mellitus type II and CAL [18,19]. Loe et al. [20] suggested that periodontitis could be regarded as the 6th complication of diabetes mellitus. Altered neutrophil function and high levels of advanced glycation end products in diabetics [21] may increase their susceptibility towards inflammatory tissue destruction leading to CAL. CAL alone cannot be used as a diagnostic criterion for periodontitis, nevertheless it can serve as a measure of the cumulative effect of periodontitis.

Tobacco smoking was found to be an independent risk indicator for CAL >5mm. This result is in accordance with the findings of previous studies which have assessed the role of smoking in periodontitis severity [22,23]. Smokers had 2.6 times higher odds to have attachment loss as compared to non smokers. Furthermore pack years had a positive correlation with CAL > 5 mm with every 1 pack year increase contributing to 0.098 mm attachment loss (Kendall's Tau coefficient=0.098) (p<0.05). Tobacco chewing was not found to be a significant risk indicator for CAL in this population. This could possibly be attributed to the low proportion of subjects (4.6%) who had this habit.

In the present study, 62.5% (20/32) of subjects who had CAL ≥ 5 mm and 30.06% (261/868) who had CAL ≤ 5 mm had poor oral hygiene as assessed by OHI(S) index. These results indicate that a higher proportion of subjects with CAL ≥ 5 mm had poor oral hygiene. These results are in accordance with the findings of López et al. [24], de Souza and Taba [25] wherein poor oral hygiene had a significant association with CAL severity. It had been postulated that plaque accumulation (poor oral hygiene) results in passage of bacteria and their products through the non keratinized junctional epithelium; leading to a series of host responses that results in pocket formation and attachment loss [26]. The effect of tooth brushing on maintenance of periodontal health has a dual role. Brushing reduces plaque accumulation and in turn prevents gingivitis, periodontitis; whereas forceful, frequent and improper brushing technique may result in gingival recession and attachment loss [27].

In this population, mean CAL did not have a normal distribution which could be considered a limitation for this study. In conclusion, this study has thrown light on the prevalence and risk indicators of CAL in an urban population of South India. Age, smoking, poor oral hygiene seem to be the key risk indicators for CAL.

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