

# Prevalence, severity and extent of chronic periodontitis among Sri Lankan adults

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**Objective:** to determine the prevalence, severity and extent of chronic periodontitis among 30-60 year old adults residing in Colombo district, Sri Lanka. **Basic research design:** a cross-sectional study with interviews and oral examinations. **Participants:** 1400, 30-60 year olds residing in Colombo district. **Results:** the prevalence of mild, moderate and severe chronic periodontitis was 1.4%, 36.1% and 13.5% respectively and the prevalence was significantly associated with sex, age group, ethnicity, level of education, smoking status and self-reported diabetes. The mean probing pocket depth (PPD) was 2.05mm (SE=0.02) and of the sample, 77% and 31% had at least one site with PPD of  $\geq 4$  and  $\geq 6$ mm respectively. The mean clinical attachment loss (CAL) was 2.53mm (SE=0.03) and 99% and 81% of the sample had at least one site with CAL of  $\geq 3$ mm and  $\geq 5$ mm respectively. The extent of periodontitis determined according to the mean percentage of sites with  $\geq 4$  and  $\geq 6$ mm of PPD were 8.40 (SE=0.34) and 1.37 (SE=0.11) respectively. Further, the extent of periodontitis according to the mean percentages of sites with  $\geq 3$  and  $\geq 5$ mm of CAL were 39.73 (SE=0.66) and 10.95 (SE=0.43) respectively. **Conclusions:** the prevalence, severity and extent of chronic periodontitis are high among adults in Colombo district. Their periodontal status was poorer than in previously reported studies conducted in the same district.

*Key words:* chronic periodontitis, prevalence, extent, severity, Sri Lanka

## Introduction

Periodontal diseases are common oral health problems that affect populations throughout the world (Petersen and Ogawa, 2012). Plaque induced gingivitis and chronic periodontitis are the two most prevalent forms (American Academy of Periodontology, 2005). Chronic periodontitis results from a complex interplay between bacterial infection and host response, modified by behavioural factors (American Academy of Periodontology, 2005).

The prevalence of periodontal diseases is high in both developed and developing countries and the distribution varies according to socio-environmental, behavioural and co-morbid conditions (Genco and Borgnakke, 2013). Although there are inter and intra-country differences in prevalence, only around 10-15% of most adult populations worldwide have severe periodontitis that may result in tooth loss (Petersen and Ogawa, 2012).

The periodontal status of populations has been assessed using various indices in the past, but due to their inherent limitations, site specific measurements of various combinations and thresholds of clinical attachment loss (CAL) and probing pocket depth (PPD) are now used in population-based studies (Baelum and Lopez, 2013). The current recommendation in periodontal epidemiology is to report data in terms prevalence and extent of CAL/ PPD at site and tooth level according to specific thresholds, severity in terms of mean CAL/

PPD and based on Centers for Disease Control and Prevention and American Academy of Periodontology (CDC/AAP) definitions (Holtfreter *et al.*, 2015)

Several studies have assessed the periodontal status of Sri Lankans. An early longitudinal study among tea labourers found that the mean clinical attachment loss (CAL) at 30 years of age was 3.1 mm, with nearly 25% of the participants having lesions  $\geq 10$ mm. The mean CAL increased to 4.5 mm by the age of 40 years (Löe *et al.*, 1978). The three National Oral Health surveys in Sri Lanka have used the Community Periodontal index (CPI) on index teeth to assess periodontal status. In the third survey conducted in 2002, 15% and 2% of 35-44 year olds had periodontal pockets of 4-5 mm and  $\geq 6$  mm respectively, while figures for these two entities in 65-74 year olds were 16% and 4% respectively (Ministry of Healthcare and Nutrition, 2009).

As patterns of disease change over time and as no studies of periodontal status have been conducted in Sri Lanka since 2002, it is time for a comprehensive study using contemporary recommendations in periodontal epidemiology (Holtfreter *et al.*, 2015). Such a study will allow for meaningful comparisons with other data collected using the same methods. Therefore the aim of the present study was to assess the prevalence, severity and extent of chronic periodontitis among 30-60 year olds with a functional dentition ( $\geq 20$  teeth) living in Colombo district in Sri Lanka.

## Methods

The Ethical Review Committee of the Faculty of Medical Sciences, University of Sri Jayewardenepura, Sri Lanka granted clearance to this study. Written informed consent was obtained from all participants.

The participants were 30- 60 year olds with a functional dentition ( $\geq 20$  teeth) who had been residents of Colombo district for a continued period of one year or more. Pregnant women, those living in business premises and religious institutions and the physically and mentally challenged were excluded. This community-based study examined participants in their homes, with them seated on a straight back chair. The oral examination took about 20-30 minutes. As pregnant women, particularly those in the second and third trimester would be uncomfortable in such a situation it was decided to exclude them from the study.

The sample size was determined using the formula for estimating a population proportion. Considering the prevalence of shallow pockets among 35-44 year olds of Colombo district (7%) (Ministry of Healthcare and Nutrition, 2009) at a 95% level of confidence and accepting a sampling error of 2%, a minimum sample of 625 was required. Making allowance for a 2% design effect of cluster sampling and a 10% non-response rate, the required sample was 1375, which was rounded to 1400.

A two stage cluster sampling technique combined with probability proportionate to size was used to select the sample. In stage one, clusters were selected. A Grama Niladhari Division (GND the smallest administrative unit in Sri Lanka) was considered as the primary sampling unit or cluster. Participants were selected from 40 clusters with a total of 35 participants from a cluster ( $1400/40=35$ ). The GNDs in Colombo district are categorized into three sectors; urban CMC (GNDs under Colombo Municipal Council (CMC), urban non CMC (GNDs under other municipal and urban councils) and rural. The 40 clusters were allocated across the three sectors based on the population proportions. Accordingly 12, 10 and 18 clusters were allocated to urban CMC, urban non-CMC and rural sectors respectively. The participants included both males and females, aged 35-44 and 45-60 years, selected based on the population proportions of these groups in Colombo district. The Grama Niladhari office of each cluster was located and the method recommended by the World Health Organization (2005) for cluster surveys was used to select the households from that point. One individual was chosen from each household.

An interviewer was used to obtain information about socio-demographics, behavioural factors and self-reported diabetes (present/absent). The oral examination included the assessment of bleeding on probing (BOP), measurement of periodontal probing depth (PPD) and clinical attachment loss (CAL) on six surfaces of all teeth (mesio-buccal, buccal, disto-buccal, disto-lingual, lingual and mesio-lingual surfaces) excluding the third molars. All periodontal parameters were recorded using the University of North Carolina (UNC) - 12 probe (Hu-Friedy Manufacturing Co, Chicago, USA)

with 1mm increments. The first author (calibrated against a professor in periodontology) conducted the oral examination under an artificial head light. A field assistant recorded the data. Following the examination, two other field assistants, one of whom was conversant in both the Sinhala and Tamil languages administered the questionnaire to the participants. In order to determine intra-examiner variability of the assessment of periodontal parameters, 5% of the sample was re-examined. Kappa statistics for intra-examiner variability of PPD and CAL measurements were 0.87 and 0.92 respectively. The questionnaire and the oral examination method were pre-tested on a sample of 15 Sinhala and Tamil speaking adults from another area.

Data were analysed using SPSS 21.0 software (SPSS Inc., Chicago, IL, USA). CDC/AAP case definitions for use in population-based studies periodontitis were used. Severe periodontitis was defined as  $\geq 2$  inter-proximal sites with CAL of  $\geq 6$ mm (not on the same tooth) and  $\geq 1$  inter-proximal sites with PPD of  $\geq 5$ mm (not on the same tooth). Moderate periodontitis was defined as  $\geq 2$  inter-proximal sites with CAL of  $\geq 4$ mm (not on the same tooth) or  $\geq 2$  inter-proximal sites with PPD of  $\geq 5$ mm (not on the same tooth) (Page and Eke, 2007). The definition for mild periodontitis was having  $\geq 2$  inter-proximal sites with CAL of  $\geq 3$ mm and  $\geq 2$  inter-proximal sites with PPD of  $\geq 4$ mm (not on the same tooth) or one site with PPD of  $\geq 5$ mm (Eke *et al.*, 2012). Prevalence data were computed as the prevalence of participants with mild, moderate and severe periodontitis based on the CDC/AAP definitions and with at least one site with PPD with  $\geq 4/\geq 6$ mm and CAL of  $\geq 3/\geq 5$ mm. Severity was computed as the mean PPD/CAL and the extent of PPD/CAL as the mean percentage of sites/teeth affected according to the thresholds. Education level was categorized into three groups; 0-5, 6-12 and  $>12$  years. Smoking status was defined as; never if never smoked during life time; former if had discontinued for more than one year before data collection and current if smoked either daily or on some days at the time of data collection. Chi square and Fisher-exact tests were used to determine associations between categorical variables. As the data on extent of PPD/CAL at site/tooth level and severity were not normally distributed non-parametric tests (Mann-Whitney and Kruskal Wallis tests) were used to determine the differences between different categories of a variable.

## Results

The mean age of the sample was 43.5 (SD $\pm$ 9.9) years. Nearly 52% were males and 80%, 11% and 8% were Sinhalese, Tamil and Muslim respectively. The mean number of teeth present was 25.4 (SD $\pm$ 2.1). Table 1 shows the association between independent variables and prevalence of chronic periodontitis.

The prevalence of mild, moderate and severe periodontitis was 1.4%, 36.1% and 13.5% respectively. The prevalence of chronic periodontitis was significantly associated with sex, age, ethnicity, level of education, smoking status and self-reported diabetes. The mean PPD was significantly higher in men (2.15mm) than women (1.94mm).

The prevalence of  $\geq 4/ \geq 6$ mm PPD and the mean percentage of sites/teeth with of  $\geq 4/ \geq 6$ mm PPD were also significantly higher in men than women. Further, the prevalence of  $\geq 4/ \geq 6$ mm PPD and the mean percentage of sites/teeth with of  $\geq 4/ \geq 6$ mm PPD increased significantly with age (Table 2).

Men (2.73mm) had higher mean CAL than women (2.31mm), a higher prevalence of  $\geq 3/ \geq 5$ mm CAL and more sites/teeth with  $\geq 3/ \geq 5$ mm CAL. The prevalence of  $\geq 5$ mm CAL and the proportion of sites affected increased with age (Table 3).

**Table 1.** Demographic and health variables and prevalence of chronic periodontitis

Variable	Chronic periodontitis				p value
	No n (%)	mild n (%)	moderate n (%)	severe n (%)	
<i>Sex</i>					
Female (678)	410 (60.5)	7 (1.0)	196 (28.9)	65 (9.6)	<0.001
Male (722)	277 (38.4)	12 (1.7)	309 (42.8)	124 (17.2)	
<i>Age group (years)</i>					
30-40 (585)	394 (67.4)	12 (2.1)	137 (23.4)	42 (7.2)	<0.001
41-50 (420)	185 (44.0)	6 (1.4)	161 (38.3)	68 (16.2)	
51-60 (395)	108 (27.3)	1 (0.3)	207 (52.4)	79 (20.0)	
<i>Ethnicity</i>					
Sinhala (1126)	568 (50.4)	14 (1.2)	386 (34.3)	158 (14.0)	0.02**
Tamil (156)	79 (50.6)	2 (1.3)	60 (38.5)	15 (9.6)	
Muslim (111)	39 (35.1)	3 (2.7)	54 (48.6)	15 (13.5)	
<i>Level of education (years)</i>					
0-5 (136)	48 (35.3)	2 (1.5)	60 (44.1)	26 (19.1)	0.004**
6-12 (1174)	582 (49.6)	17 (1.4)	420 (35.8)	155 (13.2)	
>12 (90)	57 (63.3)	0 (0.0)	25 (27.8)	8 (8.9)	
<i>Smoking</i>					
Never (1035)	591 (57.1)	12 (1.2)	324 (31.3)	108 (10.4)	<0.001**
Former (125)	44 (35.2)	1 (0.8)	57 (45.6)	23 (18.4)	
Current (240)	52 (21.7)	6 (2.5)	124 (51.7)	58 (24.2)	
<i>Self-reported diabetes</i>					
No (1248)	640 (51.3)	18 (1.4)	435 (34.9)	155 (12.4)	<0.001**
Yes (152)	47 (30.9)	1 (0.7)	70 (46.1)	34 (22.4)	
Total (1400)	687 (49.1)	19 (1.4)	505 (36.1)	189 (13.5)	

\* (Page and Eke, 2007)

Based on\*\* Fisher exact test; others chi-square test

**Table 2.** Prevalence, extent and severity of probing pocket depths according to age and sex

Variable	Prevalence (%)		Extent				Severity
	$\geq 4$ mm	$\geq 6$ mm	mean % of sites		mean % of teeth		mean PPD mm
			$\geq 4$ mm	$\geq 6$ mm	$\geq 4$ mm	$\geq 6$ mm	
<i>Sex</i>							
Female (678)	72.0 (0.02)	24.2 (0.02)	6.53 (0.41)	0.96 (0.12)	4.69 (0.20)	0.82 (0.09)	1.94 (0.02)
Male (722)	82.3 (0.01)	37.7 (0.02)	10.15 (0.54)	1.76 (0.18)	6.54 (0.26)	1.33 (0.10)	2.15 (0.03)
	p<0.001*	p<0.001*	p<0.001**	p<0.001**	p<0.001**	p<0.001**	p<0.001**
<i>Age group (years)</i>							
30-40 (585)	70.1 (0.02)	17.6 (0.02)	5.41 (0.38)	0.51 (0.07)	4.27 (0.23)	0.54 (0.07)	1.93 (0.02)
41-50 (420)	78.1 (0.02)	37.9 (0.02)	9.49 (0.68)	1.77 (0.22)	5.85 (0.29)	1.38 (0.14)	2.08 (0.03)
51-60 (395)	87.1 (0.02)	44.1 (0.03)	11.68 (0.77)	2.22 (0.29)	6.72 (0.30)	1.56 (0.15)	2.21 (0.04)
	p<0.001*	p<0.001*	p<0.00***	p<0.001***	p<0.001***	p<0.001***	p<0.001***
Total sample	77.3 (0.01)	31.1 (0.01)	8.40 (0.34)	1.37 (0.11)	5.43 (0.16)	1.08 (0.07)	2.05 (0.02)

Standard error in brackets

Based on \* chi-square, \*\*Mann-Whitney and \*\*\*Kruskal-Wallis tests

**Table 3.** Prevalence, extent of clinical attachment loss (CAL) with  $\geq 3/ \geq 5$  mm and severity of CAL according to age and sex

Variable	Prevalence (%)		Extent				Severity
	$\geq 3$ mm	$\geq 5$ mm	mean % of sites		mean % of teeth		Mean CAL
			$\geq 3$ mm	$\geq 5$ mm	$\geq 3$ mm	$\geq 5$ mm	mm
<i>Sex</i>							
Female (678)	98.7 (0.004)	72.9 (0.01)	33.90 (0.88)	7.93 (0.51)	15.39 (0.25)	4.53 (0.20)	2.31 (0.03)
Male (722)	99.9 (0.001)	87.8 (0.01)	45.20 (0.93)	13.78 (0.66)	18.36 (0.23)	7.42 (0.23)	2.73 (0.04)
	p=0.009**	p=<0.001*	p<0.001***	p<0.001***	p<0.001***	p<0.001***	p=<0.001***
<i>Age group (years)</i>							
30-40 (585)	99.0 (0.004)	66.2 (0.02)	30.24 (0.88)	4.55 (0.30)	15.68 (0.30)	3.59 (0.19)	2.14 (0.03)
41-50 (420)	99.0 (0.005)	86.0 (0.02)	41.74 (1.18)	12.06 (0.80)	17.25 (0.30)	6.65 (0.03)	2.59 (0.05)
51-60 (395)	100.0	96.2 (0.01)	51.64 (1.23)	19.23 (1.02)	18.42 (0.6)	8.94 (0.31)	3.02 (0.06)
	p=0.11**	p=<0.001*	p=<0.001#	p=<0.001#	p=<0.001#	p=<0.001#	p=<0.001#
Total sample	99.3 (0.002)	80.6 (0.01)	39.73 (0.66)	10.95 (0.43)	16.92 (0.17)	6.02 (0.16)	2.53 (0.03)

Standard error in brackets

\*Chi square, \*\*Fisher exact, \*\*\*Mann-Whitny and #Kruskal-Wallis tests

## Discussion

This comprehensive study assessed the burden of chronic periodontitis in a large representative sample of Sri Lankan adults with a  $\geq 20$  teeth residing in Colombo district using case definitions proposed by CDC/AAP (Page and Eke, 2007) and standardized principles for reporting the prevalence, severity and extent of chronic periodontitis in epidemiological studies (Holtfreter *et al.*, 2015). Except for the National Oral Health survey data from Sri Lanka, the results of the present study will only be compared with those studies that have used the CDC/AAP definitions and at least some of the same parameters proposed by Holtfreter *et al.* (2015).

The overall prevalence of moderate and severe periodontitis was 36% and 14% respectively. The prevalence of both moderate and severe periodontitis was higher among 30-40 year olds compared to the rates reported for the 35-44 year old age group from Colombo district in the third National Oral Health survey. In that survey, periodontal status was assessed using the Community Periodontal index CPI and only 7% of 35-44 year olds had pockets of 4-5mm, which indicates mild to moderate periodontitis and none had pockets of  $\geq 6$ mm (severe periodontitis) (Ministry of Healthcare and Nutrition, 2009). Although the prevalence and severity of periodontitis increases with age (Carasol *et al.* 2016), the lower prevalence rates observed in the 35-44 year olds in that survey compared to the 30-40 year old age group in the present study may be largely due to methodological issues. The CPI was recorded on index teeth in that survey and there is a strong possibility that the partial mouth examination underestimated the true burden of periodontitis (Albandar, 2011). When the prevalence of periodontitis is either low or high, partial mouth recording methods may yield invalid estimates (Demmer and Papapanou, 2010).

Despite including only those with  $\geq 20$  teeth, the burden of chronic periodontitis was higher than in large general adult populations from other countries. According to Eke *et al.* (2015), 46% of American adults aged 30 years and above have periodontitis and 9% have severe periodontitis. Likewise, the prevalence of moderate and severe periodontitis among  $\geq 15$  year old Australians was 25% and 4%

respectively (Slade *et al.*, 2007). The Study of Health in Pomerania reported the prevalence of moderate periodontitis in 20-81 year old Germans to be 33%, but the prevalence of severe periodontitis was slightly higher (18%) than the present study (Holtfreter *et al.*, 2009). Consistent with other studies using similar diagnostic criteria, the prevalence, extent and severity of periodontitis varied according to age, sex, ethnicity, education and smoking status (Eke *et al.*, 2015, Holtfreter *et al.*, 2009). Further, the prevalence of 4/6mm PPD and 3/5mm CAL was significantly higher in the present study when compared to American, German and South Korean adult populations (Eke *et al.*, 2015, Holtfreter *et al.*, 2009, Rheu *et al.*, 2011).

The severity of periodontitis assessed in terms of mean PPD and CAL was higher in the present sample than in American or South Korean adults (Eke *et al.*, 2015, Rheu *et al.*, 2011). With respect to the extent of chronic periodontitis the mean percentage of sites with PPD  $\geq 4$ mm/  $\geq 6$ mm and CAL  $\geq 3$ mm/  $\geq 5$ mm were lower in American adults when compared to the present study. However, when the extent was reported according to the mean percentage of teeth affected, the estimates for the above thresholds were higher in Americans compared to the present study (Eke *et al.*, 2015). Despite the number of teeth in Americans being slightly lower (24 teeth) than in the present study (25), more teeth were affected by chronic periodontitis in Americans compared to Sri Lankans, but in Sri Lankans the number of sites affected per tooth was higher.

It is evident that there are wide variations in the estimates of prevalence, severity and extent of chronic periodontitis. Such differences are to be expected and could be attributed to several reasons. First, there are substantial variations in the ages of participants included in studies. Levels of periodontitis are lower in young compared to older adults (Carasol *et al.* 2016). Secondly, there may be variations in exposure to risk factors in different populations, and populations, with similar characteristics may be exposed to varying degrees at different times. Thirdly, as chronic periodontitis results from a complex interaction between host immune responses and bacteria (American Academy of Periodontology, 2005), there could be individual variations in the host immune responses to microbial challenge.

Examination protocols may also vary between studies. For example, Rheu *et al.* (2011) recorded periodontal parameters on index (Ramford) teeth while the study in Pomerania used half mouth recording (Holtfreter *et al.*, 2009).

This study has some limitations. As the sample included those with  $\geq 20$  teeth there is a possibility that the burden of chronic periodontitis may have been under-estimated. The examination was carried out with participants seated on a regular chair. The use of a portable dental chair may have enhanced the data accuracy. As this study was limited to Colombo district caution is warranted when generalizing the findings to the wider population of Sri Lanka.

In conclusion these findings indicate that the prevalence, severity and extent of chronic periodontitis are high among adults residing in Colombo district. Also, the periodontal status of this group was poorer than in previous studies in the same district. Therefore there is a need for population based preventive programmes to prevent and control chronic periodontitis among adults in Colombo district, Sri Lanka.

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