

Assessment of Periodontal Health Status using Community Periodontal Index (CPI) in a Rural Population of Nepal

Dr. Bhageshwar Dhami,¹ Dr. Priti Shrestha,² Dr. Deepa G Kamath,³ Dr. Mahesh CP,⁴ Dr. Ashita Upoor⁵
Dr. Dilip G Nayak⁶

¹Department of Periodontic, Kantipur Dental College, Kathmandu, Nepal

²Department of Periodontic, M.B. Kedia Dental College, Birgunj, Nepal

^{3,5,6}Department of Periodontics, Manipal College of Dental Science, Mangalore, India

⁴Department of Periodontics, NIMS Dental College, Jaipur, India

Correspondence:

Dr. Bhageshwar Dhami, Email: dhamibhagesh@gmail.com

ABSTRACT

Introduction: Periodontal disease is one of the major cause of tooth loss. There is inflammation of gingiva and periodontal tissues along with progressive loss of alveolar bone. Clinically it is characterised by attachment loss, pocket formation, alveolar bone loss and tooth mobility. A wide range of risk factors of periodontal diseases have been identified. This study was undertaken to assess the periodontal status in a rural population of Nepal that will enable in planning, manpower development and in formulating appropriate oral health program in these rural regions of Nepal.

Objective: To assess the periodontal health status in a rural population of Nepal using CPI and to assess the correlation between oral habits and periodontal status of the rural population.

Materials and Method: A representative sample of 300 subjects aged between 15 and 74 years were interviewed. Collected data included demographic characteristics and current smoking habits. Clinical examination included the recording of periodontal health status according to the CPI.

Result: In this study, only 0.7% had healthy periodontium (Code 0). Calculus (Code 2) was the most prevalent among 43.7% followed by bleeding on probing (Code 1) in 33.3%, shallow pockets (Code 3) in 13.7% and deep pockets (Code 4) in 8.7%. Periodontal status was significantly healthier among non-smokers, females and individuals who had smoked for lesser duration.

Conclusion: The present study indicates that oral hygiene standards and periodontal health conditions need improvement in Nepal. Effective intervention programs for the prevention and control of periodontal disease are recommended at national level.

Keywords: CPI; loss of attachment; Nepal; periodontal disease.

INTRODUCTION

Periodontal diseases are a group of infectious disease resulting in the inflammation of gingival and periodontal tissues and progressive loss of alveolar bone. It is a major cause of tooth loss. It is characterised by clinically detectable loss of attachment (LOA), pocket formation, alveolar bone loss and tooth mobility. A wide range of factors such as age, sex, education, place of residence, oral hygiene habits, socioeconomic status and smoking have been identified as risk factors for the occurrence of periodontal diseases.^{1,2,3}

Community Periodontal Index of Treatment Needs (CPITN) was developed for the “joint working committee” of the “World Health Organization” (WHO) and “Federation Dentaire Internationale.” This index was developed primarily to survey and evaluate periodontal treatment needs rather than determining past and present periodontal status.⁴

Pocket depth is indeed an important aspect since it directly influences the composition of the bacterial flora,^{5,6} although it may not establish the extent of LOA. Thus recent research has been increasingly interested in LOA which determines the remaining tooth support.^{7,8}

Therefore the Community Periodontal Index (CPI) was put forth by WHO in 1997.⁹ This was a modification of the CPITN index. The modification was done by including the measurement of LOA and elimination of the treatment need category. This study was undertaken to assess the periodontal status in a rural population of Nepal that will enable in planning, manpower development and in formulating appropriate oral health programs in these rural regions of Nepal. The aims and objectives of this study are to assess the periodontal health status in a rural

population of Nepal using CPI and to assess correlation between oral habits and periodontal status of the rural population.

MATERIALS AND METHOD

Khusadevi, a village situated in Kavre district of Bagmatizone, central region of Nepal was selected for the study. A total number of 300 subjects of 15-74 years were chosen by non-probability (convenience) sampling technique. They were examined and interviewed in Mobile Dental Van and few selected houses. Intraoral examinations were carried out in a sufficient artificial spotlight with a dental probe, a dental mirror, dental forceps, and a WHO probe. A prior consent of all patients was obtained for the screening. A detailed questionnaire which included personal data regarding each subject was recorded on the proforma. The recording of data was based on the WHO Oral Health Assessment Survey Form (proforma).

Exclusion Criteria: For 15-19 years, only six index teeth were examined. Second molars were excluded and third molars were not included, except where they were functioning in place of second molars.

Inclusion Criteria: Male and female subjects from 15 to 74 years with two or more teeth present in a sextant that are not indicated for extraction.

Examination Procedure: The clinical examination included an assessment of periodontal condition using the CPI. Each subject was examined either on dental chair of mobile dental van or on an adequate natural light using a mouth mirror and CPI-C WHO Probe. The Examination was performed in a systemic manner beginning from maxillary right sextant. First it was to be decided whether the sextant could be validly scored. The requirement was that one functional tooth was present. If only one functional teeth were present, then

Table 1: Periodontal condition in relation to gender, education, and smoking.

Percentage of persons who have the highest score							
N	Female	Male	Collegiate	High school	Primary	No education	
0	2	0	1.3	1.1	0.8	0	0
1	100	38.9	27.8	40	37.9	10	19.1
2	131	45.6	41.7	50	43.9	70	30.9
3	41	13.4	13.9	4.4	9.1	20	33.8
4	26	2.1	15.2	4.4	8.3	0	16.2

Distribution of the population by maximum CPI scores in relation to gender ($p < 0.001$ hs) and education ($p < 0.001$ hs)

the sextant was scored 'X' (minimum of two functional teeth have to be present) and the next sextant was examined. The index teeth were also examined immediately after recording the CPI score for that particular sextant for the presence of any visible attachment i.e., LOA was measured if cemento-enamel junction (CEJ) was visible and recorded according to the criteria. The maximum loss of LOA in the index teeth was measured from CEJ to the maximum penetration of CPI-C probe. The appropriate highest score for each sextant was determined and recorded in the appropriate box.

Number of probing per sextant: The tip of the probe was gently inserted parallel to the long axis of the tooth, between the tooth and gingiva starting at the distobuccal surface of index tooth, to the full depth of the sulcus or pocket and the probing depth was read by observing the black position of the black band. The sides probed were the distal, midline and mesial on both facial and lingual/palatal surfaces. The probing was done gently by moving with short upward and downward movements from distal to mesial surface towards the contact area along the buccal sulcus. A similar procedure was carried out for the lingual surfaces starting distolingually to the index tooth.

The following **CPI coding system** was used to record periodontal status: 0, healthy periodontium; 1, bleeding observed after probing; 2, calculus detected during probing, but the black band on the probe was visible; 3, pocket 4–5mm (the black band on the probe is within the gingival margin); 4, pocket =6mm (black band on the probe not visible); X, excluded sextant (>2 teeth present); and 9, not recorded.

Statistical Analysis: The collected data were entered into the computer database and analyzed using the Statistical Package SPSS in the Department of Community Medicine, Kasturba Medical College, Mangalore. Chi Square test was applied for comparing the associations. A p value of less than 0.05 was considered as significant.

RESULTS

Prevalence data measured by CPI: The overall prevalence of periodontitis in the examined Nepalese rural population is shown in Table 1. Healthy periodontal conditions (CPI0) were found in only 0.7% of the examined population. Gingival bleeding (CPI1) was observed in

27.8% of the population. Gingival bleeding and calculus were present (CPI2) in 43.7% of the individuals examined. In 33.3% of the participants, shallow periodontal pockets (4–5 mm) were recorded (CPI3) in at least one sextant. A deep pocket (CPI4) existed in at least one sextant in 8.7% of the subjects.

Association between periodontal condition and demographic determinants:

Gender and Age: The 29% percent of males versus 15.5% of females had a high (>2) CPI score, and males were over-represented in all high (3, 4) and under-represented in all low (0–2) score categories ($p<0.001$; Table 1). The distribution of the adult population by maximum CPI scores in relation to age is shown in Table 2. It clearly demonstrates that a CPI score of 2 was the most prevalent (gingival bleeding and calculus) in all age groups and this prevalence first increased, and later decreased with age; overall, a significant tendency towards deterioration of periodontal status with age was observable ($p=0.001$).

Education: On the basis of the educational status, the study population was divided into four groups, Group I (Collegiate) made up to 30%, Group II (Middle and High school) made up to 44%, Group III (Primary School) 3.3% and Group IV (No formal education) 22.7% of the total sample. This result suggests that subjects with a lower level of education (those with only primary education and those with no formal education demonstrated a higher degree of periodontal disease than those with higher level of education (Table 1). This association was highly significant ($p<0.001$).

Occupation: The study population was divided into six groups on their basis of their occupation. Of the total sample, Group I (Farmers) constituted 43.3%, Group II (Unskilled workers) constituted 2%, Group III (Skilled workers) constituted 15.3%, Group IV (Semi-professionals) constituted 15.7%, Group V (Professionals) constituted 1% and Group VI (Students) constituted 22.7%. Thus, it can be calculated that the students, professionals and semi-professionals had less periodontal destruction than farmers, unskilled and skilled workers. This association was statistically highly significant ($p<0.001$) (Figure 1).

Smoking: In the population studied, 66.3% were non-

smokers and 33.7% were smokers. Among smokers 21.7% were light smokers (those smoking less than 10 cigarettes a day) and 12% were heavy smokers (those smoking more than 10 cigarettes a day). It can thus be concluded that the non-smokers had better periodontal status than smokers. This association was highly significant. ($p < 0.001$) (Table 3). In this study, 39.6% smoked less than 10 years, 40.6% smoked for less than 10 to 20 years and 19.8% smoked for more than 20 years. The results thus suggest that those who smoked for lesser duration of time had less periodontal destruction than the subjects who smoked for longer duration. This association was statistically not significant. Among the study sample 26.7% had oral habits like tobacco and betel nut chewing and 73.3% did not. The result indicates that nonchewers had better periodontal status than chewers. The association was highly significant ($p < 0.0001$) (Table 4).

Income: On the basis of income per month, the study population was divided into four groups. Group I consisted of the subjects who earned 0-1000 Nepalese Rupees per month, Group II Rs 1100-2000, Group III Rs 2100-3000 and Group IV 3100 and above. It can thus be concluded that persons earning Rs 3100 per month or above had healthy periodontium than persons earning lesser than Rs 3000 per month (Table 4).

Oral hygiene habits: Evaluation of the questionnaire assessing oral hygiene habits indicated that brushing with a toothbrush was the most commonly used method i.e. 75.7%, tooth powder with finger 11.7% and 12.7% (charcoal, ash and sand). The result suggest that the amount of periodontal destruction exhibited by the subjects using toothbrush were less than the destruction observed in those using tooth powders, charcoal, ash and sand. This association was highly significant. ($p < 0.001$) (Table 5). In this study, 5.7% cleaned more than twice daily, 17% cleaned twice a day, 58.3% cleaned once in a day and 19% cleaned occasionally. These results suggest that the subjects who cleaned their teeth twice a day or more than twice a day had less periodontal destruction than the subjects who cleaned once or occasionally. This association was highly significant. ($p = 0.004$) (Table 5).

DISCUSSION

The CPITN combines scoring of gingivitis, calculus and periodontitis, regarding the highest numeric value for a site. No accurate estimation can be determined of gingivitis or calculus because they may or may not be combined with periodontitis. The exceptional rule to this rule is the CPITN score 0, which describe a healthy

Table 2: Periodontal conditions by age.

Percentage of persons who have the highest score						
N	healthy	bleeding	Calculus	Pd 4-5mm	Pd 6+mm	
15 years	2	0	81.3	18.8	0	0
16-34	100	0.7	40.4	52.9	4.4	1.5
35-44	131	0	10.9	67.4	13	8.7
45-64	41	1.9	13	31.5	37	16.7
65-74	26	0	21.9	15.6	28.1	34.4

Distribution of the population by maximum CPI scores in relation to age ($p = 0.001$ hs)

Table 3: Periodontal condition with smoking.

Percentage of persons who have the highest score							
N	Non-smoker	Light smoker	Heavy smoker	=10 yrs>	10yrs & =20yrs	>20yrs0	
0	2	1	0	0			
1	100	44.2	16.9	2.8	12.5	12.5	10
2	131	49.2	44.6	11.1	42.5	31.7	15
3	41	5	26.2	38.9	15	41.5	40
4	26	0.5	12.3	47.2	30	14.6	35

Distribution of the population by maximum CPI scores in relation to smoking (Light smoker = 10 cigarettes/day and Heavy smoker = > 10 cigarettes/day) ($p < 0.001$ hs) and duration of smoking ($p = 0.074$ ns).

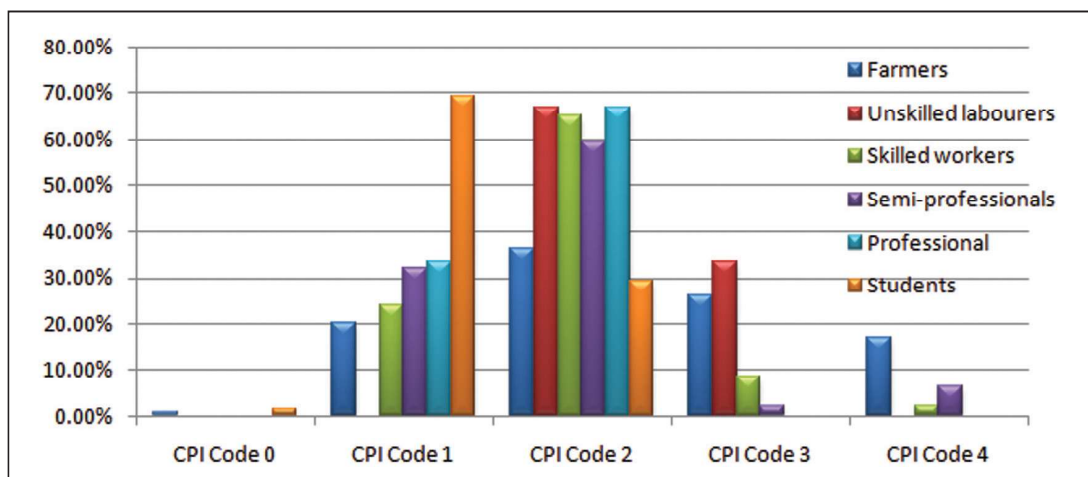


Figure 1: Periodontal condition and occupation.

Table 4: Periodontal condition with income and chewing habits.

Percentage of persons who have the highest score							
N	0-1000Nrs	1100-2000Nrs	2100-3000Nrs	3100-4000Nrs	Chewer	Non-chewer	
0	2	0	0	0	0.8	0	0.9
1	100	20	29.2	28.6	34.6	2.5	44.5
2	131	60	37.5	46.4	43.6	21.3	51.8
3	41	0	25	17.9	12.3	45	2.3
4	26	20	8.3	7.1	8.6	31.3	0.5

Distribution of the population by maximum CPI scores in relation to smoking (Light smoker = 10 cigarettes/day and Heavy smoker = > 10 cigarettes/day) ($p < 0.001$ hs) and duration of smoking ($p = 0.074$ ns).

Table 5: Periodontal condition with tooth cleaning device and frequency.

Percentage of persons who have the highest score								
N	TB + TP	TP+ Finger	Others	>twice a day	twice a day	Once a day	Occasionally	
0	2	0.9	0	0	0	0	1.1	0
1	100	41.4	2.9	13.2	29.4	41.2	35.4	21.1
2	131	48.5	42.9	15.8	52.9	41.2	47.4	31.6
3	41	6.6	31.4	39.5	11.8	13.7	9.1	28.1
4	26	2.6	22.9	31.6	5.9	3.9	6.9	19.3

Distribution of the population by maximum CPI scores in relation to tooth cleaning device (TB+TP- toothbrushing and toothpaste, TP+finger-Toothpowder and other- charcoal, ash, sand etc.) ($p < 0.001$ hs) and frequency of teeth cleaning ($p = 0.004$ hs).

sextant.¹⁰ Using the highest CPI score is recommended by the WHO (1997); however, the CPI index has some limitations.

In the present study, the prevalence of periodontal disease was found to be 99.3% in the subjects, i.e., only 0.7% had a completely healthy periodontium (Code 0) as their highest CPI score. This is in accordance with other studies.^{11,12,13} Lack of proper dental health knowledge

and awareness and the virtual absence of preventive and therapeutic dental services could be the factors responsible for this rather alarming state of unhealthy amongst this backward, rural community. This is comparable with the study by Kurien et al (1996) in their unpublished data of community needs in the village of Hebri, South India.

Calculus (Code 2) and bleeding on probing (Code 1)

were the most frequently observed conditions followed by shallow and deep pocket. This is in agreement with several earlier studies.^{14,15,16} The prevalence of gingivitis, and calculus in the 15-year age group in our study is similar to that seen in previous study^{17,18} where bleeding is more predominant than calculus. At the age of 35-44 years there were relatively few subjects with deep pockets i.e. 8.7% but at the age of 45-64 and 65-74 years, the percentage affected increased reaching 18.5-25% respectively. This is in agreement with previous studies.^{19,20}

The relationship of the sex of the subjects and the incidence of periodontal disease shows that the prevalence of advanced periodontal disease amongst the female was less than that observed amongst the males (Table 1). This is in agreement with several earlier studies.²¹⁻²⁸

The detrimental effect of tobacco smoking on the periodontal tissue was demonstrated in this study, corroborating earlier reports.²⁸⁻³¹ Smoking, considered to be one of the risk factors of advanced periodontal disease^{28,30,31} was found to be lesser amongst the female subjects of this rural population. This could be a contributing factor for the better periodontal status in females. The estimated risk of periodontal destruction for smokers increased, compared to the non-smokers. Non-smokers in general had less periodontal destruction than smokers. This value is comparable to those obtained by Goultschin (1990).²⁹ The percentage of subjects with deep pockets (Code 4) were observed to be more in heavy cigarette smokers, followed by light smokers and least in nonsmokers. This finding demonstrates the detrimental effect of tobacco has on the periodontal tissues, which is in accordance with other studies.^{28,30,31} Various factors such as altered host response,^{32,33} changes in oral microflora³⁴ may probably contribute to more severe forms of periodontal disease in smokers. There was a direct correlation observed in this study between number of cigarettes smoked per day, duration of smoking and periodontal destruction. This finding is in accordance with other studies.^{35,36} A higher percentage of heavy smokers (those smoking more than 10 cigarettes per day) had deeper pocket and more LOA. Although the mechanisms by which tobacco exerts its influence are not clearly known, it seems likely that it primarily has a systemic influence affecting host response or susceptibility.³² The results suggest that smoking influences the prevalence and severity of periodontal diseases and

thus favor the hypothesis that it is a major risk factor for periodontal disease.

The habit of tobacco and betel nut chewing was also shown to adversely affect the health of the periodontal tissues of the subjects. This finding is in agreement with earlier reports.³⁷⁻³⁹ Prevalence of gingival recession was observed to be more in subjects with chewing habits than non chewers in the present study. Gingival recession and advanced periodontal destruction have been reported adjacent to the regions where the tobacco quid is held.^{37,38} This greater severity of gingival recession observed in the present study could probably be the result of mechanical injury to the gingiva. Holm (1994)³⁹ has shown that increased prevalence of gingival recession could be attributed not only to mechanical but chemical irritating effect of smokeless tobacco components. According to him, this stimulus is likely to result in the release of inflammatory mediators, toxic substances such as nitrosamines, which may play a role in the development of periodontal LOA and gingival recession. These observations lend credence to the view that control of such deleterious habits could pave the way to a great extent in promoting periodontal health.

A significant correlation was observed between the occupational status and the periodontal condition. All the professionals, semi-professionals, skilled workers had lesser periodontal destruction than the farmers, unskilled workers. Both higher socioeconomic status and higher educational level have been strongly associated with a decrease in the oral hygiene scores, and, thus indirectly, the prevalence and severity of gingivitis and periodontitis.⁴⁰ Therefore, with an improvement in the social and educational status and a change in life style, an improvement in the oral hygiene practices could be expected, along with an improvement in gingival health. This study demonstrated a relation between the educational level of the subjects and the periodontal status. With a decrease in the overall level of education, a deterioration of the health of the periodontal tissue was evident. This observation is in agreement with the observations of other authors.^{40,41} An increased level of education and regularity of dental visits have been strongly associated with improved dental knowledge⁴² whereas poor education has been implicated as one of the risk indicators for a higher prevalence of periodontal disease.⁴³ A large number of individuals with a lower level of education (no formal education) were found to use other methods to clean their

teeth. Similarly, harmful habits like smoking and tobacco chewing were found to be more amongst those with no formal education and with only primary education. All these factors could have contributed to their poor periodontal health.

The various oral hygiene practices employed by this rural population included the use of toothbrush and tooth paste, tooth powder and others like charcoal, ash and sand. It was observed that the majority of subjects used other methods. The toothbrush users were found to have better periodontal health when compared to tooth powder and other method users. This is in agreement with other studies.^{41,44-46} Greene⁴⁴ noticed both in urban and rural samples in India that tooth brush users had lower periodontal disease scores than those who used the finger as a means of cleaning the teeth, while Ramfjord,⁴⁶ in an attempt to compare methods of oral hygiene with the periodontal scores, showed that the use of a brush was associated with a lower periodontal disease score than other methods of oral hygiene. This reinforces the belief that to date, the most dependable mode of plaque control is mechanical cleaning with a toothbrush.

Results of this study indicate a high prevalence of bleeding on probing, calculus and shallow pockets among the population examined, which shows that effectiveness of the oral hygiene methods employed amongst them is not very high and further, that the low number of dental professionals in Nepal are unable to treat these conditions adequately. The present study approaches the problem of periodontal disease by placing special emphasis on untreated disease and analyzing the importance of extrinsic risk factors such as conditions of life, attitudes, knowledge and habits. Data of this kind allow conclusions to be drawn regarding the association between untreated disease and related risk factors. However, though CPI includes measurement of LOA, determination of LOA is in general not sufficient for the assessment of the periodontal status. As CPI measurements are done only in index teeth, it can overestimate or underestimate the prevalence of periodontal disease. A disadvantage of the CPI is that, by using the highest score per sextant and not individual tooth scores, the extent of periodontal disease within and between individuals and populations is poorly defined. CPI codes could be recorded as non-contiguous, distinct categories for each tooth rather than a sextant score. In this way, the index would be more representative of the disease distribution within the mouth. As new diagnostic aids

such as tests that detect pathogenic bacteria or actively deteriorating periodontal sites become validated, their incorporation into CPI should be explored to better detect and assess destructive periodontal diseases.

It has been reported that CPI (CPITN) underestimates the prevalence and severity of clinical LOA in older age groups and overestimates these parameters in younger groups (Aucott & Ashley 1986, Baelum et al 1995). The use of CPI (CPITN) in the epidemiology of periodontal disease is controversial (Baelum and Papapanou 1996). Although the original intent of the CPITN was to assess for increasing periodontal treatment needs in a population, the evolution of CPI from CPITN has created confusion towards its use as a method to assess periodontal status. The need to produce accurate assessments of periodontal outcome measures in research, intervention, and surveillance activities is important as dental researchers and public health professionals attempt to reduce disease disparity.

It has been said that a hallmark of a good index for measuring health status is its simplicity of use, rapid application in the field, clear criteria for use, reproducibility by multiple examiners, and accuracy in quantification of conditions (Horowitz 1978). Given the lack of universal support for CPI as well as other methodologies employed in periodontal epidemiology, the time may be right for a renewed debate leading to the development of appropriate measures for use in periodontal epidemiology. One of the limitations of this study is that it was a cross-sectional study. Collecting data from single point in time does not allow for an assessment of disease activity or progression.

CONCLUSION

Data of the present study show that in an elderly population group, there is a high prevalence of periodontal disease in different degrees in the subjects in general, but only few individuals suffer from severe generalised periodontal destruction. This study revealed that poor oral hygiene habits, negligence of dental office attendance, inferior quality of restorative care and smoking habits could be responsible for poor periodontal conditions.

The present study indicates that oral hygiene standards and periodontal health conditions need improvement in Nepal. Effective intervention programs for the prevention

and control of periodontal disease are recommended at a national level. The results of this study establish baseline data, which could help in planning and evaluating oral health programs. It is recommended that dental health services should be more directed at motivating people

towards oral hygiene and providing them with oral hygiene instructions. Regular dental screening should be performed on regular basis in order to evaluate these programs and to refer people with unhealthy periodontium for periodontal treatment.

REFERENCES

1. Enwonwu, CO, Edozien, JC Epidemiology of periodontal disease in Western Nigerians in relation to socio-economic status. *Arch Oral Biol.* 1970 Dec;15(12):1231-44.
2. Honkala E, Freeman, R. Oral hygiene behavior and periodontal status in European adolescents; an overview. *Community Dent Oral Epidemiol.* 1988 Aug;16(4):194-8.
3. Kingman, A. Statistical management of periodontal data. *Periodontol 2000.* 1993 Jun;46-56.
4. Ainamo J, Barmes D, Beagrie G, Cutress T, Martin J, Sardo-Infirri J. Development of the World Health Organization (WHO) community periodontal index of Treatment Needs (CPITN). *Int Dent J.* 1982 Sep;32(3):281-91.
5. Listgarten MA, Slots J, Rosenberg J, Nitkin L, Sullivan P, Oler J. Clinical and microbiological characteristics of treated periodontitis patients on maintenance care. *J Periodontol.* 1989 Aug;60(8):452-9.
6. Socransky SS. Microbiology of periodontal disease -- present status and future considerations. *J Periodontol.* 1977 Sep;48(9):497-504.
7. Goodson JM, Tanner AC, Haffajee AD, Sornberger GC, Socransky SS. Patterns of progression and regression of advanced destructive periodontal disease. *J Clin Periodontol.* 1982 Nov;9(6):472-81.
8. Socransky SS, Haffajee AD, Goodson JM and Lindhe J. New concepts of destructive periodontal disease. *J Clin Periodontol.* 1984 Jan;11(1):21-32.
9. World Health Organization (WHO). *Oral Health Surveys. Basic Methods.* 4th ed. Geneva; World Health Organization;1997.
10. Taani Q. The periodontal status of Jordanian adolescents measured by CPITN. *Int Dent J.* 1995 Dec;45(6):382-95.
11. Flores-de-Jacoby L, Bruchmann S, Mengel R, Zafiroopoulos GG. Periodontal conditions in Rio de Janeiro City (Brazil) using the CPITN. *Community Dent Oral Epidemiol.* 1991 Apr;19(2):127-8.
12. Kawamura M, Sasahara H, Kawabata K, Iwamoto Y, Konishi K, Wright FA. Relationship between CPITN and oral health behaviour in Japanese adults. *Aust Dent J.* 1993 Oct;38(5):381-8.
13. Lopez NJ, Rios V, Fernandez O. Periodontal conditions in 15-19-year-old Chileans. *Int Dent J.* 1996 Jun;46(3):161-4.
14. Powell RN, McEniery TM. The Brisbane Statistical Division Survey of Adult Dental Health 1984.3. Dental Health Status and treatment needs. *Aust Dent J.* 1988;33(2):109-15.
15. Baelum V, Fejerskov O, Manji F, Wanzala P. Influence of CPITN partial recordings on estimates of prevalence and severity of various periodontal conditions in adults. *Community Dent Oral Epidemiol.* 1993 Dec;21(6):354-9.
16. Baelum V, Manji F, Fejerskov O, Wanzala P. Validity of CPITN's assumptions of hierarchical occurrence of periodontal conditions in a Kenyan population aged 15-65 years. *Community Dent Oral Epidemiol.* 1993 Dec;21(6):347-53.
17. Kerosuo E, Kerosuo H, Kallio P, Nyandini U. Oral health status among teenage school children in Dar es Salaam, Tanzania. *Community Dent Oral Epidemiol.* 1986 Dec;14(6):338-40.
18. Pilot T, Barmes DE, Leclercq MH, McCombie BJ, Sardo Infirri J. Periodontal conditions in adolescents, 15-19 years of age: an overview of CPITN data in the WHO Global Oral Data Bank. *Community Dent Oral Epidemiol.* 1987 Dec;15(6):336-8.
19. Gaengler P, Goebel G, Kurbad A, Kosa W. Assessment of periodontal disease and dental caries in a population survey using the CPITN, GPM/T and DMF/T indices. *Community Dent Oral Epidemiol.* 1988 Aug;16:236-9.
20. Songpaisan Y, Davies GN. Periodontal status and treatment needs in the Chiangmai/Lamphun provinces of Thailand. *Community Dent Oral Epidemiol.* 1989 Aug;17(4):196-9
21. Freitas E, Meyer K, Davis RK, Kristofferson T. A baseline study of periodontal conditions among youths and adults in Portugal. *Community Dent Oral Epidemiol.* 1983 Aug;11(4):250-4.
22. Garcia ML, Cutress TW. A national survey of periodontal treatment needs of adults in the Philippines. *Community Dent Oral Epidemiol.* 1986 Dec;14(6):313-6.
23. Corbet EF, Holmgren CJ, Lim LP, Davies WI. Sex differences in the periodontal status of Hong Kong adults aged 35-44 years. *Community Dent Health.* 1989 Mar;6(1):23-30.
24. Pilot T, Lu ZY, Lin ZQ, Yen WP, Cao GR. Periodontal conditions in 35-44-year-old factory workers in Shanghai. *Community Dent Oral Epidemiol.* 1989 Aug;17(4):216.

25. Skaleric U, Kovac-Kavic M. Periodontal treatment needs in a population of Ljubljana, Yugoslavia. *Community Dent Oral Epidemiol.* 1989 Dec;17(6):304-6.
26. Mengel R, Koch H, Pfeifer C, Flores-de-Jacoby L. Periodontal health of the population in eastern Germany (former GDR). *J Clin Periodontol.* 1993 Nov;20(10):752-5.
27. Smith AC, Lang WP. CPITN, DMFT and treatment requirements in a Nicaraguan population. *Community Dent Oral Epidemiol.* 1993 Aug;21(4):190-3.
28. Bergstrom J. Cigarette smoking as risk factor in chronic periodontal disease. *Community Dent Oral Epidemiol.* 1989 Oct;17(5):245-7.
29. Goultschin J, Cohen HD, Donchin M, Brayer L, Soskolne WA. Association of smoking with periodontal treatment needs. *J Periodontol.* 1990 Jun;61(6):364-7.
30. Ismail AI, Burt BA, Eklund SA. Epidemiological pattern of smoking and periodontal disease in the United States. *J Am Dent Assoc.* 1983 May;106(5):617-21.
31. Preber H, Bergstrom H. Cigarette smoking in patients referred for periodontal treatment. *Scand J Dent Res.* 1986 Apr;94(2):102-8.
32. Bridges RB, Kraal JH, Huang LJ, Chancellor BM. Effects of tobacco smoke on chemotaxis and glucose metabolism of polymorphonuclear leukocytes. *Infect Immun.* 1977 Jan;15(1):115-23.
33. Kenney EB, Krall JH, Saxe SR, Jones J. The effect of cigarette smoke on human oral polymorphonuclear leukocytes. *J Periodontal Res.* 1977 Jul;12(4):227-34.
34. Kenney EB, Saxe SR, Bowles RD. The effect of cigarette smoking on anaerobiosis in the oral cavity. *J Periodontol.* 1975 Feb;46(2):82-5.
35. Grossi SG, Zambon J, Machtei EE, Schifferle R, Andreana S, Genco RJ, et al. Effects of smoking and smoking cessation on healing after mechanical periodontal therapy. *J Am Dent Assoc.* 1997 May;128(5): 599-607.
36. Kaldahl WB, Johnson GK, Patil KD, Kalkwarf KL. Levels of cigarette consumption and response to periodontal therapy. *J Periodontol.* 1996 Jul; 67(7):675-81.
37. Christen AG. The clinical effects of tobacco on oral tissues. *J Am Dent Assoc.* 1970 Dec;81(6):1378-82.
38. Christen AG, Armstrong WR, McDaniel RK. Intraoral leukoplakia, abrasion, periodontal breakdown, and tooth loss in a snuff dipper. *J Am Dent Assoc.* 1979 Apr;98(4):584-6.
39. Holm G. Smoking as an additional risk for tooth loss. *J Periodontol.* 1994 Nov;65(11):996-1001.
40. Kelly JE, Van Kirk LE. Periodontal disease in adults. United States - 1960-62. Vital and Health Statistics, PHS Pub no. 1000, Series 11, No 12. Public Health Service, Washington DC: US Government Printing Office; 1965.
41. Chiranjeevi K, Wade AB. Periodontal effects of national health service on an immigrant population. *J Periodontol.* 1972 Dec;43(12):718-22.
42. Schwarz E, Lo EC. Dental health knowledge and attitudes among the middle-aged and the elderly in Hong Kong. *Community Dent Oral Epidemiol.* 1994 Oct;22(5):358-63.
43. Fox CH. New considerations in the prevalence of periodontal disease. *Curr Opin Dent.* 1992 Mar;2:5-11.
44. Greene JC. Periodontal disease in India: report of an epidemiological study. *J Dent Res.* 1960 Mar;39(2):302-12.