

Comparative Study of Lifestyle-related Risk Factors of Periodontal Disease among Urban and Rural Population of India

¹Ritesh Singla, ²Shashidhar Acharya, ³Nishu Singla

ABSTRACT

Aim: To compare participants' lifestyle-related risk factors for periodontal disease between urban and rural population.

Materials and methods: A cross-sectional study consisting of a structured questionnaire on health practice index (HPI), oral health-related behavior, and personal habits as well as socio-demographic variables was conducted on 800 subjects aged 20 to 50 years attending dental outreach centers of Manipal College of Dental Sciences in urban and rural areas of Udupi District. Clinical examination for periodontal status was done by using community periodontal index, simplified oral hygiene index, and gingival index. Statistical analysis of the data was done using chi-square.

Results: It was found that except the number of hours of work/day ($p=0.02$) urban participants had significantly better occupations, higher education, more income, better oral health care behaviors like dental visits, device of cleaning, frequency of cleaning, method of cleaning, healthier personal habits like tobacco chewing, pan chewing (<0.001 respectively), physical exercise, mental stress levels and healthier overall lifestyles ($p<0.001$ respectively) than the rural participants. It was also found that more number of urban participants had better oral hygiene status ($p<0.001$), gingival status ($p<0.001$), and healthier periodontium ($p=0.002$) than the rural counterparts.

Conclusion: These findings suggest that rural participants had more lifestyle-related risk factors for periodontitis as well as less healthy periodontium than the urban participants. Patient's involvement in self-care by promoting healthy lifestyles is needed especially in rural areas where adequate treatment facilities are lacking.

Keywords: Lifestyles, Periodontal disease, Risk factors, Rural, Urban.

How to cite this article: Singla R, Acharya S, Singla N. Comparative Study of Lifestyle-related Risk Factors of Periodontal Disease among Urban and Rural Population of India. *World J Dent* 2016;7(3):129-134.

Source of support: Nil

Conflict of interest: None

INTRODUCTION

Periodontal disease is one of the major dental problems that affect people worldwide at high prevalence rates.^{1,2} Considerable differences in the distribution of periodontal disease are observed in populations living in certain geographic regions or locations. It was noticed in the National Oral Health Survey and Fluoride Mapping (2002–2003)³ and in the multicentric study carried out in India by Shah et al⁴ that general trend for loss of attachment (LOA) was higher in the rural population than in the urban population. It is believed that the variation in the periodontal health status of urban and rural population of India can be mainly attributed to their differences in lifestyles, culture, and religious beliefs.

The fact that chronic periodontitis is closely linked to lifestyles and affected by behavioral factors has been reported in various studies,^{5,6} since the way in which an individual lives may produce behavioral patterns that are either beneficial or detrimental to health. Behavioral risk factors which have been found to affect the periodontal diseases in many studies⁷⁻¹⁵ were dental attendance, tooth brushing frequency, method of tooth brushing, use of interdental cleaning aids, smoking, alcohol consumption, physical activity, mental illness, dietary habits, sleeping hours, etc. If health is to be improved, there is a need to investigate various lifestyles as risk factors and actions must be directed toward their rectification.

The rural–urban differences in the prevalence of periodontal diseases indicate that lifestyle characteristics and conventional risk factors may be important. Hence, there is a need to find out the lifestyle-related differences between the urban and rural population related to their periodontal health. As known, the majority of the Indian population live in rural areas which are devoid of adequate treatment facilities; patient's involvement in self-care by promoting healthy lifestyles is a necessity in the country like India. This study is an attempt to compare the lifestyle-related risk factors of periodontal disease between urban and rural population of Dakshina Kannada District of Karnataka State.

MATERIALS AND METHODS

The present study was a cross-sectional study carried out on the subjects of age group 20 to 50 years attending

¹Reader, ²Professor and Head, ³Assistant Professor

¹Department of Orthodontics, Manipal College of Dental Sciences, Manipal University, Manipal, Karnataka, India

^{2,3}Department of Public Health Dentistry, Manipal College of Dental Sciences, Manipal University, Manipal, Karnataka, India

Corresponding Author: Nishu Singla, Assistant Professor Department of Public Health Dentistry, Manipal College of Dental Sciences, Manipal University, Manipal, Karnataka, India, Phone: +919964504403, e-mail: nishu-gupta@hotmail.com

the dental outreach centers of Manipal College of Dental Sciences in Udupi district, Karnataka. The dental centers provide dental care to the population of Udupi district and the surrounding areas. Ethical approval to conduct the study was obtained from the Ethical Committee of the Manipal University. Informed consent was taken from all the participants prior to the study. The self-administered questionnaires were then distributed to 400 urban and 400 rural subjects. Out of which 780 participants returned the completed questionnaires with the acceptable response rate of 97.5%.

The eligibility criteria which had been used for the inclusion of the subjects in the study were those who were willing to participate, between the age group of 20 and 50 years, and able to read the questionnaire. The following subjects were excluded: Those who were not willing to participate, subjects undergoing orthodontic treatment, any medically compromised conditions contraindicating the oral examination like infective endocarditis, HIV/AIDS, individuals with any medical conditions which may influence the periodontal health, such as diabetes, pregnancy, anti-inflammatory drugs or tetracycline or vitamin C supplements from last 6 months, drugs which can cause gingival enlargement, e.g., Phenytoin (Dilantin), numerous calcium channel blocker agents, such as Nifedipine, Amlodipine, and Cyclosporin.

A pilot survey on 25 urban subjects and 25 rural subjects was carried out prior to the commencement of the study in order to assess their periodontal status. Among the urban group, 48% (n = 12) of the subjects and among the rural group, 64% (n = 16) of the subjects had periodontal disease. The sample size required to carry out the study was calculated taking confidence level at 95% (Z, standard value of 1.96) and margin of error at 5% (d, standard value of 0.05). Calculating the sample size by the given prevalence, values obtained were 384 and 354 respectively.¹⁶ Therefore, a final sample size of 400 was chosen for each group.

A structured questionnaire was prepared consisting of four parts:

The first part of the questionnaire included respondents' sociodemographic characteristics in terms of age, gender, location, marital status, income/month, education, occupation, and religion.

The second part of the questionnaire consisted of questions regarding oral health-related behavior like frequency of dental visits, device of cleaning, frequency of cleaning, and method of cleaning.

The third part of the questionnaire was an eight-item health practice index (HPI) scale for the evaluation of the total lifestyle.¹⁷⁻²⁰ The eight items on the self-administered questionnaire used were developed by Morimoto; that included information regarding smoking, consuming

alcohol, eating breakfast, hours of sleep/night, hours of work/day, physical exercise, nutritional balance, and mental stress. Subjects selected one of 2 to 6 multiple choices of each item, and the answer was classified as indicating either "good" or "poor" health practices according to Morimoto's criteria. The "good" health practices were given the code of 1 and "poor" health practices were coded as 0. Each subject was then assigned a total score between 0 and 8 based on number of good health practices and classified into one of the following three categories as poor lifestyles (score = 0–3), moderate lifestyles (scores = 4, 5), and good lifestyle (scores = 6 or higher). In the present study, in addition to HPI, tobacco chewing and paan chewing behavior were evaluated as it is integral habit to the culture of study area.

The fourth part consisted of information on clinical periodontal health status. Loss of attachment of periodontal tissues was recorded using the community periodontal index (FDI/WHO-1982). Loss of attachment with at least 1 site ≥ 4 mm was considered as case defining criteria for periodontitis.²¹ Oral hygiene status was assessed with oral hygiene status index and gingival status was assessed with gingival index.

Kannada is the regional language of Karnataka; hence, the questionnaire was translated into Kannada language. The validity was checked by a back translation method, involving blind retranslation into English. The validity of translation was verified by experts in both languages. This was also checked after wording modification, in order to ensure the functional and conceptual equivalence of the questionnaire.

One trained and calibrated dentist conducted all-clinical oral examinations with the trained recorder recording the observations. Before conducting the survey, the training and calibration of examiner was done in Comprehensive Dental Care Center of Department of Public Health Dentistry, Udupi, under the guidance and supervision of the faculty of the Department. Training for the indices used in the study was done on 10 patients with wide ranging levels of oral disease. Subsequently, a total of 20 patients were examined on two occasions over 2 successive days. Intra-examiner reliability was assessed using κ statistic, which was in the range of 0.85 to 0.92 for the indices, which reflected a high degree of conformity in the observations. Recorder was instructed in the coding systems of the indices used in the study.

A schedule was prepared for data collection based on an average time of 10 to 12 minutes for clinical examination per individual. The study was scheduled for the months of January 2011 to April 2011. Twenty to thirty subjects were examined per day. The clinical examination was carried out by the examiner following "Universal Precautions".

STATISTICAL ANALYSIS

Statistical analysis of the data was done using Statistical Package for the Social Sciences (SPSS) version 11.5. The analysis of the data was done using chi-square test. The cut-off level for statistical significance was taken at 0.05.

RESULTS

There was an approximately equal distribution of the study sample with respect to gender in both the urban and the rural population. The urban sample consisted of 48.2% males and 51.8% females and the rural sample consisted of 50.8% males and 49.2% females. Participants were dichotomized into two age groups, i.e., 20 to 35 and 36 to 50 years, each age group consisted of about 50% of the total participants in both the urban and rural study groups. There was a statistically significant difference between the urban and the rural participants, when they were compared against their occupations, education, and income. It was noticed that urban participants had significantly better occupations, higher education, and more income as compared to the rural participants in the present study (Table 1).

On evaluating the oral hygiene behavior, it was revealed that the urban participants had significantly better oral health care behaviors like frequency of cleaning ($p < 0.001$), device of cleaning ($p < 0.001$), method of cleaning ($p < 0.001$), and dental visits ($p < 0.001$) than the rural participants. Also, almost doubled the number of urban participants (61.7%) had reported to brush "twice daily" than the rural participants (36.1%) of the present study. Majority of patients from both urban and rural preferred to use toothbrush as compared to other aids. However, it was seen that more of rural population (5.4%) as compared to urban population (0.5%) used finger or datun as cleaning aid. Regarding brushing technique, maximum number of patients of both the group preferred combined method of brushing rather than only vertical or horizontal method of tooth brushing. Moreover, nearly 50% of the rural participants reported that they had "never" visited a dentist before as opposed to 43.6% of the urban participants that had visited a dentist before (Table 2).

On comparing the personal habits of the study population, it was found that more number of urban participants reported to have longer working hours a day than the rural participants ($p = 0.02$), still the urban participants had significantly healthier personal habits, like tobacco chewing ($p < 0.001$), pan chewing ($p < 0.001$), physical exercise ($p < 0.001$), and mental stress levels ($p < 0.001$) than the rural participants of the present study (Table 3). The overall lifestyles also significantly differed among the urban and rural participants ($p < 0.001$).

Table 1: Distribution of study population according to the demographic characteristics

		Urban n (%)	Rural n (%)
Gender	Male	189 (48.2%)	197 (50.8%)
	Female	203 (51.8%)	191 (49.2%)
Age	20–35 years	196 (50.0%)	198 (51.0%)
	36–50 years	196 (50.0%)	190 (49.0%)
Marital	Married	311 (79.3%)	282 (72.7%)
	Single	81 (20.7%)	106 (27.3%)
Occupation*	Unemployed	178 (45.4%)	169 (43.6%)
	Unskilled	22 (5.6%)	115 (29.6%)
	Skilled/semiskilled	55 (14.0%)	56 (14.4%)
	Clerical, farmer, business	112 (28.6%)	46 (11.9%)
	Semi-professional/professional	25 (6.4%)	2 (0.5%)
Education*	Primary school	17 (4.3%)	127 (32.7%)
	Middle school	28 (7.1%)	97 (25.0%)
	High school	97 (24.7%)	76 (19.6%)
	P.U.C/Diploma	82 (20.9%)	64 (16.5%)
	Graduate/Postgraduate	168 (42.9%)	24 (6.2%)
Income/month*	<5,000 rupees	63 (16.1%)	240 (61.9%)
	5,001–20,000 rupees	190 (48.5%)	141 (36.3%)
	20,001–50,000 rupees	97 (24.7%)	6 (1.5%)
	>50,000 rupees	42 (10.7%)	1 (0.3%)
Religion	Hindu	247 (63.0%)	217 (55.9%)
	Christian	84 (21.4%)	127 (32.7%)
	Muslims	58 (14.8%)	44 (11.3%)
	Others	3 (.8%)	0
Total		392 (100%)	388 (100%)

*Difference among urban and rural groups of the study population for occupation, education, and income is statistically significant ($p < 0.001$, $p < 0.001$, and $p < 0.001$); n = number of participants

Table 2: Comparison of urban and rural study population in relation to oral health-related behavior

		Urban n (%)	Rural n (%)	p-value
Dental visits	Once in 1–2 years	171 (43.6%)	76 (19.6%)	<0.001
	Rarely	147 (37.5%)	136 (35.1%)	
	Never	74 (18.9%)	176 (45.4%)	
Device of cleaning	Toothbrush	390 (99.5%)	367 (94.6%)	<0.001
	Finger	2 (0.5%)	18 (4.6%)	
	Any other	0	3 (0.8%)	
Frequency of cleaning	Once	146 (37.2%)	244 (62.9%)	<0.001
	Twice	242 (61.7%)	140 (36.1%)	
	More	4 (1.0%)	4 (1.0%)	
Method of cleaning	Vertical	55 (14.0%)	106 (27.3%)	<0.001
	Horizontal	36 (9.2%)	46 (11.9%)	
	Both	301 (76.8%)	236 (60.8%)	
Total		392 (100%)	388 (100%)	

p-value < 0.05 is considered significant, n = number of participants

Though, majority of the participants both in the urban (78.8%) and rural groups (67.5%) had good lifestyles, the greater proportion of the rural participants (7.2%) had poor lifestyles as compared to the urban participants (2.6%) (Table 4).

Table 3: Comparison of the urban and rural study population in relation to personal habits

Habit		Urban n (%)	Rural n (%)	p-value
Tobacco consuming*	Good	373 (95.2%)	330 (85.1%)	<0.001
	Poor	19 (4.8%)	58 (14.9%)	
Paan chewing*	Good	379 (96.7%)	340 (87.6%)	<0.001
	Poor	13 (3.3%)	48 (12.4%)	
Smoking**	Good	348 (88.8%)	328 (84.5%)	0.08
	Poor	44 (11.2%)	60 (15.5%)	
Alcohol consumption**	Good	385 (98.2%)	379 (97.7%)	0.60
	Poor	7 (1.8%)	9 (2.3%)	
Breakfast**	Good	354 (90.3%)	354 (91.2%)	0.65
	Poor	38 (9.7%)	34 (8.8%)	
Sleep/night**	Good	278 (70.9%)	251 (64.7%)	0.06
	Poor	114 (29.1%)	137 (35.3%)	
Work/day**	Good	278 (70.9%)	304 (78.4%)	0.02
	Poor	114 (29.1%)	84 (21.6%)	
Physical exercise**	Good	156 (39.8%)	83 (21.4%)	<0.001
	Poor	236 (60.2%)	305 (78.6%)	
Diet**	Good	292 (74.5%)	269 (69.3%)	0.11
	Poor	100 (25.5%)	119 (30.7%)	
Stress**	Good	378 (96.4%)	326 (84%)	<0.001
	Poor	14 (3.6%)	62 (16%)	
Total		392 (100%)	388 (100%)	

*Not included in HPI; **According to Health Practice Index – HPI; p-value <0.05 is considered significant, n = number of participants

Table 4: Comparison of overall lifestyles (combined HPI variable) of the study participants among the urban and rural groups

Lifestyle (HPI)	Urban n (%)	Rural n (%)	p-value
Poor lifestyle*	10 (2.6%)	28 (7.2%)	<0.001
Moderate lifestyle**	73 (18.6%)	98 (25.3%)	
Good lifestyle***	309 (78.8%)	262 (67.5%)	
Total	392 (100%)	388 (100%)	

*Poor (0–3 HPI scores); **Moderate (4, 5 HPI scores); ***Good (6–8 HPI scores); Good habit = 1 score, Poor habit = 0 score, Total score of Health Practice Index = 0–8 score p <0.05 considered as significant, n = number of participants

It was also seen that more number of urban participants had better oral hygiene status (p <0.001), gingival status (p <0.001), and healthy periodontium (p = 0.002) than the rural counterparts (Table 5).

DISCUSSION

A wide variation in the periodontal health status of urban and rural population was seen in the present study as it was reported in the earlier studies.^{3,4,22} Urban participants of the current study had better oral hygiene status, gingival status, and lesser LOA of the periodontal tissues than the rural participants. These findings were similar to the findings reported by Greene,²³ Yonemitsu et al²⁴ and Varenne et al.²⁵ The purpose of this study was to find the lifestyle-related risk factors responsible for this

Table 5: Comparison of oral hygiene status, gingival status, and periodontal status of study participants between the urban and rural groups

		Urban n (%)	Rural n (%)	p-value
Oral hygiene status*	Good	79 (20.2%)	33 (8.5%)	<0.001
	Fair	224 (57.1%)	193 (49.7%)	
	Poor	89 (22.7%)	162 (41.8%)	
Gingival status**	Mild gingivitis	240 (61.2%)	114 (29.4%)	<0.001
	Moderate gingivitis	140 (35.7%)	221 (57.0%)	
	Severe gingivitis	12 (3.1%)	53 (13.7%)	
Loss of attachment***	Present	166 (44.5%)	207 (55.5%)	0.002
	Absent	226 (55.5%)	181 (44.5%)	
Total		392 (100%)	388 (100%)	

*Oral hygiene index-simplified; **Gingival index; ***Community periodontal index; p <0.05, considered as significant

variation in the periodontal health status of urban and rural people which are discussed as follows:

It is a well-known fact that periodontal health is closely linked to socioeconomic status (SES) and has long been reported that periodontal diseases are more frequent and more severe among individuals of lower SES than those of higher SES.²⁶⁻²⁹ This is one of the social parameters for which a vast diversity can be seen across the Indian population. There exists a wide economic gap between urban and rural India. These differences were evident in the present study population as urban participants had significantly better occupations, higher education, and more income as compared to the rural participants.

The behaviors related to personal oral hygiene and utilization of dental care services play an important role in periodontal disease. In the present study, it was revealed that urban participants had significantly better oral hygiene behavior than the rural participants, as almost double the number of urban participants reported to brush twice daily. In addition, more of rural population reported finger use or datun as cleaning aid as compared to urban population which were similar to the findings reported in a study by Kapoor et al.³⁰ The reason could be the greater awareness, better knowledge, and understanding of dental problems among the urban population. Moreover, it was observed that there was low oral health-seeking behavior among the rural people which was similar to the finding reported by Gill et al³¹ and Devaraj and Eswar.³² The reason could be the lesser number of dentists, poorer oral health care infrastructure, and inaccessible services available in rural areas.³³

The urban participants of the present study had significantly healthier personal habits than the rural counterparts. Earlier studies have shown the effect of smokeless tobacco on oral tissues and on periodontal health.^{34,35} Smokeless tobacco consumption and paan chewing habit was reported, significantly higher among the rural participants in the present study which was similar to the findings reported in the studies done by Chockalingam et al³⁶ and Gupta et al.³⁷ These studies have also demonstrated more prevalence of habit of smoking among the rural people, but in the present study the habit of smoking and drinking alcohol did not differ significantly among the two groups. This may be due to social desirability bias of the participants which can arise as a result of self-reporting of the data.

A rural environment has different lifestyles compared to an urban city. Lifestyle is understood as discrete behaviors which are linked directly to health outcomes. An individual's health depends a lot on their lifestyle. In the present study whether the participants have overall good lifestyle or not was derived with the help of a HPI given by Morimoto, which was based on the eight habits of an individual. Not smoking, not consuming alcohol every day, eating breakfast every morning, sleeping 7 to 8 hours per night, working less than 10 hours per day, exercising at least once a week, eating a nutritionally balanced diet, and keeping mental stress levels moderate were considered as good lifestyle practices. According to the present study, it was observed that, although majority of the participants both in the urban and rural groups had good lifestyles but the greater proportion of the rural participants had poor lifestyles as compared to the urban participants.

Certain lifestyle factors, such as stress, lack of physical activities, food habits, and lack of sleep are known to increase the risk of periodontal disease.⁷⁻¹⁵ In the present study, more of the rural participants reported to have excessive stress levels as compared to urban participants. It may be related to SES which is the most important predictor of stress-related disorders. Regular physical exercise can help to prevent a wide range of health problems. In the present study, lesser number of rural participants has reported the habit of exercising in the morning than the urban participants. However, regarding the working hours, it was seen that more number of urban participants reported longer working hours a day than the rural participants. Other lifestyle factors which were considered in the present study like eating breakfast, hours of sleep per night, and eating nutritional balanced diet did not show any difference among the two groups.

CONCLUSION

The above discussion gives an indication that rural population in India is more susceptible to periodontal disease because of unhealthy lifestyles and personal habits compounded with poor accessibility to dental facilities, poverty, and illiteracy. Maintenance of good oral hygiene, physical health, mental health, and diet regulation is crucial to an individual's overall health and quality of life. Simple lifestyle changes, such as brushing twice daily, can help people to improve or protect their oral health. Therefore, specific efforts targeted to increase awareness toward healthy lifestyles are required which can further help to improve self-oral health care and hence aid in prevention of periodontal diseases especially in those areas where adequate treatment facilities are lacking.

REFERENCES

1. Petersen PE. The World Oral Health Report 2003: continuous improvement of oral health in the 21st century – the approach of the WHO Global Oral Health Programme. *Community Dent Oral Epidemiol* 2003 Dec;31 (Suppl 1):3-23.
2. Ramfjord SP, Emslie RD, Greene JC, Held AJ, Waerhaug J. Epidemiological studies of periodontal diseases. *Am J Public Health Nations Health* 1968 Sep;58(9):1713-1722.
3. Bali RK, Mathur VB, Talwar PP, Chanana HB. National oral health survey & fluoride mapping, 2002-2003, India. Delhi: Dental Council of India; 2004.
4. Shah N, Pandey RM, Duggal R, Mathur VP, Rajan K. Oral health in India: a report of the multi centric study. Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India and World Health Organisation Collaborative Program; 2007 Dec.
5. Locker D, Jokovic A, Payne B. Life circumstances, lifestyles and oral health among older Canadians. *Community Dent Health* 1997 Dec;14(4):214-220.
6. Sakki TK, Knuuttila ML, Anttila SS. Lifestyle, gender and occupational status as determinants of dental health behavior. *J Clin Periodontol* 1998 Jul;25(7):566-570.
7. Sbaraglia M, Turnbull RS, Locker D. Risk indicators for periodontal disease in a remote Canadian community – a dental practice-based study. *J Public Health Dent* 2002 Winter;62(1): 51-56.
8. Shizukuishi S, Hayashi N, Tamagawa H, Hanioka T, Maruyama S, Takeshita T, Morimoto K. Life style and periodontal health status of Japanese factory workers. *Ann Periodontol* 1998 Jul;3(1):303-311.
9. Bergstrom J. Cigarette smoking as risk factor in chronic periodontal disease. *Community Dent Oral Epidemiol* 1989 Oct;17(5):245-247.
10. Shimazaki Y, Saito T, Kiyohara Y, Kato I, Kubo M, Iida M, Yamashita Y. Relationship between drinking and periodontitis: the Hisayama Study. *J Periodontol* 2005 Sep;76(9):1534-1541.
11. Kibayashi M, Tanaka M, Nishida N, Kuboniwa M, Kataoka K, Nagata H, Nakayama K, Morimoto K, Shizukuishi S. Longitudinal study of the association between smoking as a periodontitis risk and salivary biomarkers related to periodontitis. *J Periodontol* 2007 May;78(5):859-867.

12. AL-Zahrani MS, Borawski EA, Bissada NF. Increased physical activity reduces prevalence of periodontitis. *J Dent* 2005 Oct;33(9):703-710.
13. Linden GJ, Mullally BH, Freeman R. Stress and the progression of periodontal disease. *J Clin Periodontol* 1996 Jul;23(7):675-680.
14. Jenzsch A, Eick S, Rassoul F, Purschwitz R, Jentsch H. Nutritional intervention in patients with periodontal disease: clinical, immunological and microbiological variables during 12 months. *Br J Nutr* 2009 Mar;101(6):879-885.
15. Bawadi HA, Khader YS, Haroun TF, Al-Omari M, Tayyem RF. The association between periodontal disease, physical activity and healthy diet among adults in Jordan. *J Periodontal Res* 2011 Feb;46(1):74-81.
16. Abramson JH, Abramson ZH. Survey methods in community medicine. 5th ed. Edinburgh: Churchill Livingstone; 1999. p. 89-103.
17. Kusaka Y, Kondou H, Morimoto K. Healthy lifestyles are associated with higher natural killer cell activity. *Prev Med* 1992 Sep;21(5):602-615.
18. Belloc NB. Relationship of health practices and mortality. *Prev Med* 1973 Mar;2(1):67-81.
19. Morimoto K. Life-style and genetic factors that determine the susceptibility to the production of chromosome damage. In: Obe G, Natarajan AT, editors. Chromosomal aberrations: basic and applied aspects. Berlin: Springer-Verlag; 1990. p. 287-301.
20. Ezoe S, Morimoto K. Behavioural lifestyle and mental health status of Japanese factory workers. *Prev Med* 1994 Jan;23(1):98-105.
21. Tomar SL, Asma S. Smoking-attributable periodontitis in the United States: findings from NHANES III. National Health and Nutrition Examination Survey. *J Periodontol* 2000 May;71(5):743-751.
22. Kamath DG, Varma BR, Kamath SG, Kudpi RS. Comparison of periodontal status of urban and rural population in Dakshina Kannada District, Karnataka State. *Oral Health Community Dent* 2010;4:34-37.
23. Greene JC. Periodontal disease in India: report of an epidemiological study. *J Dent Res* 1960 Mar;39(2):302-312.
24. Yonemitsu M, Watanabe H, Minakuchi S, Ono Y, Ohnishi M, Kubota K, Sasaki Y. Epidemiological study on distribution of plaque, calculus and gingivitis among Nigerian people. *Kokubyo Gakkai Zasshi* 1993 Dec;60(4):565-570.
25. Varenne B, Petersen PE, Ouattara S. Oral health behaviour of children and adults in urban and rural areas of Burkina Faso, Africa. *Int Dent J* 2006 Apr;56(2):61-70.
26. Borrell LN, Crawford ND. Socioeconomic position indicators and periodontitis: examining the evidence. *Periodontol* 2000 2012 Feb;58(1):69-83.
27. Borrell LN, Beck JD, Heiss G. Socioeconomic disadvantage and periodontal disease: the Dental Atherosclerosis Risk in Communities study. *Am J Public Health* 2006 Feb;96(2):332-339.
28. Nanaiah KP, Nagarathna DV, Manjunath N. Prevalence of periodontitis among the adolescents aged 15-18 years in Mangalore City: an epidemiological and microbiological study. *J Indian Soc Periodontol* 2013 Nov;17(6):784-789.
29. Susin C, Haas AN, Valle PM, Oppermann RV, Albandar JM. Prevalence and risk indicators for chronic periodontitis in adolescents and young adults in south Brazil. *J Clin Periodontol* 2011 Apr;38(4):326-333.
30. Kapoor D, Gill S, Singh A, Kaur I, Kapoor P. Oral hygiene awareness and practice amongst patients visiting the Department of Periodontology at a Dental College and Hospital in North India. *Indian J Dent* 2014 Apr;5(2):64-68.
31. Gill M, Pal K, Gambhir RS. Oral hygiene practices, attitude, and access barriers to oral health among patients visiting a rural dental college in North India. *J Dent Res Rev* 2014 Dec;1(3):114-117.
32. Devaraj CG, Eswar P. Association between socio-demographic factors and dental service utilization among people visiting a dental college hospital in India: a descriptive cross-sectional study. *Indian J Stomatol* 2011;2(4):212-215.
33. Singla N, Acharya S, Martena S, Singla R. Effect of oil gum massage therapy on common pathogenic oral microorganisms – a randomized controlled trial. *J Indian Soc Periodontol* 2014 Jul;18(4):441-446.
34. Kumar S, Prabu D, Kulkarni S, Dagli RJ. Tobacco as risk factor for periodontal disease in green marble mine laborers of Rajasthan, India. *Braz J Oral Sci* 2008;7(27):1641-1647.
35. Singh GP, Soni BJ. Prevalence of periodontal diseases in urban and rural areas of Ludhiana, Punjab. *Indian J Community Med* 2005 Oct-Dec;30(4):128-129.
36. Chockalingam K, Vedhachalam C, Rangasamy S, Sekar G, Adinarayanan S, Swaminathan S, Menon PA. Prevalence of tobacco use in urban, semi urban and rural areas in and around Chennai City, India. *PLoS One* 2013 Oct;8(10):e76005.
37. Gupta V, Yadav K, Anand K. Patterns of tobacco use across rural, urban, and urban-slum populations in a north Indian community. *Indian J Community Med* 2010 Apr;35(2):245-251.