Periodontal Health Knowledge and Smoking are Associated with Periodontal Treatment Need according to Tooth Brushing Levels

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ABSTRACT

Objective: *The aim of this study is to determine whether periodontal health knowledge is associated with frequency of tooth brushing and periodontal treatment need.*

Methods: *Four hundred and two subjects participated in the study. Data on sociodemographic variables (age, gender, marital status, income, and education), general health, smoking behaviour, tooth cleaning habits and knowledge on periodontal health/disease were collected with a questionnaire. Periodontal treatment need was examined using the Community Periodontal Index of Treatment Needs (CPITN). According to the CPITN scores, the treatment needs were grouped as minimum (CPITN = 0), low-level (CPITN = 1−2), or high-level (CPITN = 3−4).*

Results: *Statistical differences were found between the frequency of tooth brushing and smoking status, marital status, periodontal health knowledge and periodontal treatment needs. Gender (females), place of residence (urban areas), education and periodontal health knowledge had positive relationship with tooth brushing frequency, while smoking and periodontal treatment need had negative relationship. When multivariate logistic regression analysis was applied, age, marriage and poor periodontal knowledge were associated with increased low-level periodontal treatment needs, and age, marriage and smoking were associated with increased high-level periodontal treatment need.*

Conclusion: *In the limits of this study, we suggest that gender, smoking habits, marital status, place of residence, education and periodontal health knowledge are determining factors related to tooth brushing frequency. Periodontal knowledge and smoking are associated with periodontal treatment needs.*

Keywords: Periodontal health knowledge, periodontal treatment need, smoking, tooth brushing levels

Los Conocimientos de Salud Periodontal y el Hábito de Fumar se Encuentran Asociados con la Necesidad de Tratamiento Periodontal de Acuerdo con los Niveles de Cepillado Dental

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RESUMEN

Objetivo: *El objetivo de este estudio fue determinar si el conocimiento de salud periodontal se halla asociado con la frecuencia del cepillado dental y la necesidad de tratamiento periodontal.*

Métodos: *Cuatrocientos dos sujetos participaron en el estudio. Mediante encuestas, se recogieron datos sobre las variables sociodemográficas (edad, género, estado civil, ingreso, y educación), salud general, comportamiento hacia el fumar, hábitos de limpieza de los dientes, y conocimientos en relación con la enfermedad/salud periodontal. Se examinó la necesidad de tratamiento periodontal usando Sin embargo el Índice de Necesidades de Tratamiento Periodontal de la Comunidad (CPITN), De conformidad con las puntuaciones de CPITN, las necesidades de tratamiento se clasificaron como mínimas (CPITN = 0), bajo nivel (CPITN = 1-2), o alto nivel (CPITN = 3-4).*

Resultados: *Se encontraron diferencias estadísticas entre la frecuencia del cepillado dental con el estatus en torno al hábito de fumar, estado civil, conocimiento de salud periodontal y necesidades del*

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tratamiento periodontales. El género (las hembras), lugar de residencia (las áreas urbanas), la educación y el conocimiento de salud periodontal guardaron una relación positiva con la frecuencia del cepillado dental, mientras que el fumar y la necesidad de tratamiento periodontal, guardaban una relación negativa. Al aplicar el análisis de regresión logística multivariante, se halló que la edad, el matrimonio y el pobre conocimiento periodontal se encuentran asociados con el aumento de la necesidad de de alto nivel.

Conclusión: *En los límites de este estudio, se sugiere que el género, hábito de fumar, estado civil, lugar de residencia, educación, y conocimientos de salud periodontal, son factores determinantes relacionados con la frecuencia de cepillado dental. El conocimiento periodontal y el hábito de fumar están asociados con las necesidades del tratamiento periodontales.*

Palabras claves: Conocimientos de salud periodontal, necesidad de tratamiento periodontal hábito de fumar, niveles de cepillado dental

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INTRODUCTION

Oral diseases such as dental caries and periodontal diseases are still prevalent problems in many parts of the world without regard for geopolitical boundaries. This is especially so in the developing and non-developed countries than in developed countries. The prevalence of periodontal diseases in developing and developed countries such as Turkey and Finland is decreasing but in the non-developed countries, it is increasing (1, 2).

The prevalence of periodontal diseases has decreased from 97% in 1987 to 84.4% in 2004 for adults in Turkey (3−5). Whereas, this prevalence has decreased from 98% during 1982–1983 to 64% in 2000 for adults in Finland (3, 6). However, the percentage of persons with periodontitis has been increasing with age (7, 8).

Pathogenic bacterial biofilm at and below the gingival margin is the main aetiological agent of periodontitis (9). Nevertheless, the role of hereditary or acquired conditions which diminish the immune response, such as diabetes, obesity, or HIV, play a part in the disease formation. Smoking, on the other hand, is considered to be an important behavioural factor in the aetiology of periodontitis (10). In addition to these risk factors, sociodemographic factors are believed to participate in the initiation and progression of periodontal diseases (11).

There are limited number of studies on the relationship of periodontal knowledge and periodontal health. Earlier studies on periodontal knowledge level of the subjects suggested that knowledge is only weakly associated with periodontal disease, and increasing knowledge level does not lead to improved oral hygiene practices (12, 13).

In the present study, we evaluated the association between periodontal health knowledge, sociodemographic factors and smoking with tooth brushing frequency and periodontal treatment needs.

SUBJECTS AND METHODS

Four hundred and two patients, who were referred to Kirikkale University, Faculty of Dentistry, were included in this study. Age range was 18 to 66 years (mean age was 32.8 ± 10.6); 196 of the subjects were female and 206 of them were male. All protocols were approved by the Kirikkale University ethics committee.

Participants' sociodemographic variables (age, gender, marital status, income, place of residence and education), smoking behaviours, tooth brushing frequencies, systemic conditions and periodontal knowledge were collected by questionnaire. Smoking status was grouped as smokers and non-smokers. Education was grouped as elementary school graduate or below, high school graduate and university (licentiate or a higher degree) graduate. Income was grouped as lowest 1/3, middle 1/3 and highest 1/3. Tooth brushing habits were grouped as random, once a day, or more than once a day.

Periodontal health knowledge was quantified with the answers to the following questions, modified from El-Qaderi and Ta'ani (14) and Alwaeli and Al-Jundi (15):

1) What is dental plaque?
Correct answer: Soft deposits on teeth
2) What is calculus?
Correct answer: Hard deposits on teeth
3) What does gingival bleeding means?
Correct answer: Inflamed gingiva
4) How can you prevent gum diseases?
Correct answer: by tooth brushing and flossing

Periodontal knowledge was scored as 1: Poor level (no correct answer), 2: Moderate level (1 to 2 correct answers) and 3: High level (3 to 4 correct answers).

Periodontal treatment need of patients was determined using the procedures for the Community Periodontal Index of Treatment Needs [CPITN] (16, 17). The maxilla and mandible were divided into three segments: two premolars-molar

segments and one anterior (canine-canine) segment. Six segments were assessed for each individual. Pocket depths were measured at six sites around each tooth (mesial, midline, and distal on both vestibule and lingual/palatal surfaces). If less than two functional teeth existed, the sextant was classified as edentulous. Third molars were excluded unless they were mesially located and functioning in the place of second molars. Each sextant was assigned a code number and the condition of the worst affected site in that sextant was recorded. The subjects were classified into treatment needs categories according to the highest code number (18−20).

In the present study, instead of using the five-score system of CPITN, subjects were categorized in two groups according to their CPITN scores. Categorizing the CPITN scores were used earlier in analysing the periodontal status (21−22). With categorizing the scores, we believe that the weaknesses of sextant based CPITN evaluation in detecting the periodontal treatment need were minimized. Subjects' periodontal treatment needs were classified according to their CPITN scores as follows: minimum (CPITN = 0), low-level periodontal treatment need (CPITN = 1−2), or high-level periodontal treatment need [CPITN = 3−4] (23−26).

Data were analysed using the Statistical Package for Social Sciences (SPSS) version 10.0 (Chicago, IL, 1997) statistical software. The Chi-square test, Fisher's Exact Test, and an analysis of variance (ANOVA) test were used for comparisons of demographic variables and periodontal knowledge between the groups. The effect of sociodemographic variables and periodontal health knowledge on the periodontal treatment need were assessed by using multifactorial logistic regression analysis.

RESULTS

Characterization of the study population according to the frequency of tooth brushing, age, gender, smoking status, place of residence, marital status, education, income, periodontal health knowledge and periodontal treatment need scores are presented in Table 1 and the Figure.

Table 1: Study population by sociodemographic factors, periodontal health knowledge and CPITN (Community Periodontal Index of Treatment Needs)

		Frequency of tooth brushing								
		Random		Once a day		Twice a day or more		Chi-square test		
		Smoker n: 73	Non-smoker n: 53	Smoker n: 62	Non-smoker n: 61	Smoker n: 66	Non-smoker n: 87	Smoker	Non-smoker	Whole population
Age (mean ± sd. dev.)		35 ± 10	34 ± 12	34 ± 9	35 ± 10	34 ± 10	31 ± 12	0.867[a]	0.127[a]	0.154[a]
Gender (%)	Male	69.9	41.5	59.7	44.3	59.1	34.5	0.332	0.453	0.100
	Female	30.1	58.5	40.3	55.7	40.9	65.5			
Residence (%)	Urban	86.3	81.1	87.1	88.5	95.5	93.1	0.159[b]	0.094	0.039*
	Rural	13.7	18.9	12.9	11.5	4.5	6.9			
Marital status (%)	Single	26.0	49.1	24.2	27.9	27.3	52.9	0.923	0.007*	0.023*
	Married	74.0	50.9	75.8	72.1	72.7	47.1			
Education (%)	Elementary or below	26.0	30.2	22.6	29.5	21.2	23.0	0.282	0.814	0.237
	High school	45.2	26.4	40.3	29.5	31.8	27.6			
	University of higher	28.8	43.4	37.1	41.0	47.0	49.4			
Income (%)	Low	17.8	17.0	19.4	11.5	10.6	12.6	0.618	0.717	0.601
	Middle	42.5	54.7	45.2	52.4	43.9	48.3			
	High	39.7	28.3	35.5	36.1	45.5	39.1			
Periodontal knowledge questions (% of correct answers)	0	9.6	18.9	6.5	4.9	0.0	6.9	0.086[b]	0.079[b]	0.014*
	1	15.11	13.2	9.7	6.6	16.7	4.6			
	2	35.6	28.3	35.5	24.6	37.9	28.7			
	3	38.4	34.0	41.9	47.5	36.4	48.3			
	4	1.4	5.7	6.5	16.4	9.1	11.5			
CPITN	Minimum (Score 0)	2.7	17	6.5	6.6	10.6	4.6	0.111	0.040[b]*	0.038*
	Low-level (Score 1−2)	65.8	67.9	77.4	85.2	68.2	88.5			
	High-level (Score 3−4)	31.5	15.1	16.1	8.2	21.2	6.9			

a. ANOVA was used in comparison between groups.

b. Fisher's Exact test was used when the validity of the Chi-square test is violated due to small frequencies in the cells.

* indicates statistical difference ($p < 0.05$).

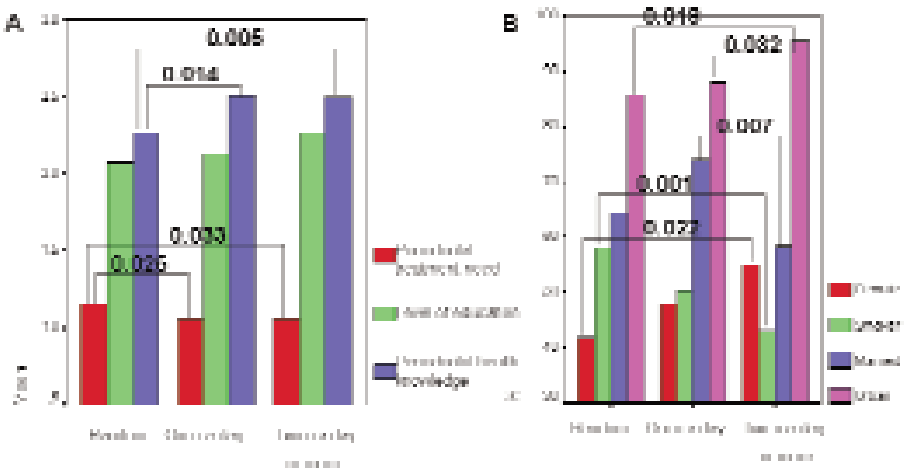

Figure: Study population by sociodemographic factors, periodontal treatment need, and periodontal health knowledge according to their frequency of tooth brushing.

A: Mean values of the parameters with discrete (qualitative) values. Categorization of each parameter is as follows: periodontal treatment need: 0 = minimum, 1 = low, 2 = high; level of education: 1 = elementary or below, 2 = high school, 3 = university or higher; periodontal health knowledge: 0 = no correct answer, 1 = 1–2 correct answers, 2 = 3–4 correct answers.

B: Percentages of parameters with nominal (quantitative) values. Statistical differences are given with *p*-values.

Among the study population, 85.3% of study subjects were systemically healthy, 4% had hormonal diseases, 9% had metabolic diseases, 1% had chronic infectious diseases and 0.8% had blood diseases. Distributions of the subjects with diseases were not statistically different among the groups.

Periodontal treatment need scores and number of smokers were significantly higher in the "random tooth brushing" group than those of "once a day" or "twice a day or more" tooth brushing groups [Figure] ($p < 0.05$). The number of females and subjects living in urban areas were higher in the "once a day" tooth brushing group than those of the "random tooth brushing" group and highest in the "twice a day or more" tooth brushing group. Education and periodontal health knowledge scores were also higher in the "once a day" tooth brushing subjects than those of "random brushing" subjects, and scores of the "twice a day" were the highest among all groups.

Table 2 represents the results of logistic regression analysis of subjects' periodontal treatment needs according to groups (low-level and high-level). Values in the Table give the odds ratios for each risk factor, in separate calculations. According to the results, older age, being married and poor periodontal health knowledge were found to be associated with low-level treatment need. On the other hand, older age, being married and smoking were found to be associated with high-level treatment need.

When periodontal health knowledge and smoking were included into the same model with age (Table 3), the estimate was higher than when they were analysed separately (Table 2).

DISCUSSION

Periodontal diseases are multifactorial chronic diseases (7, 8). The main finding of this study was that tooth brushing frequency is associated with sociodemographic factors and periodontal health knowledge. Poor periodontal health knowledge was associated with low-level treatment need and smoking was associated with high-level treatment need. Furthermore, inclusion of both age and periodontal health knowledge in the logistic regression model resulted in a stronger association with treatment needs, in comparison with the ones achieved by the use of each marker individually.

Earlier studies have demonstrated that sociodemographic factors, such as low income, ethnicity and education play a role in periodontal disease pathogenesis (27). As far as we are aware, there is very limited data on the importance of periodontal health knowledge for periodontal status. One limitation of our study was that there is no "international consensus" on periodontal health knowledge evaluation. In our study, questions defining the periodontal health knowledge were kept simple and easily understandable. Open-ended questions were not included. In order to minimize the effect of misunderstandings in the questions, periodontal health knowledge scores were grouped as no correct answer, one to two correct answers and three to four correct answers. Another limitation of the present study is the use of CPITN in defining periodontal status and treatment need. Use of CPITN in epidemiological studies has been criticized before (23, 24). The main objection is that the prevalence and severity of periodontal attachment loss is underestimated in CPITN evaluations among older subjects and overestimated

Table 2: Unadjusted associations of sociodemographical factors and periodontal health knowledge with periodontal treatment need. In the left column, low-level treatment need was taken as the dependent factor and minimum treatment need as the reference category. In the right column, high-level need was taken as the dependent factor and low-level need as the reference category.

		Low-level treatment need Odds ratios (95% confidence limits)	**High-level treatment need Odds ratios (95% confidence limits)**
Age		1.091 (1.039 – 1.146)	1.037 (1.011 – 1.063)
Smoking	Smoker	1.117 (0.525 – 2.381)	2.895 (1.624 – 5.161)
	Non-smoker	0	0
Marital status	Married	2.297 (1.076 – 4.906)	2.321 (1.212 – 4.445)
	Single	0	0
Level of education	Primary school/uneducated	6.433 (0.140 – 1.344)	0.524 (0.269 – 1-024)
	High school	0.539 (0.163 – 1.784)	0.810 (0.422 – 1.553)
	University or higher	0	0
Number of daily tooth brushing	Not daily/random	1.452 (0.602 – 3.504)	0. 444 (0.237 – 0.832)
	Once a day	1. 637 (0.629 – 4.257)	0.406 (0.206 – 0.803)
	Twice a day or more	0	0
Periodontal health knowledge	Score 1	4.128 (1.398 – 12.193)	0.503 (0.103 – 1.381)
	Score 2	3.848 (1.268 – 11.683)	0.780 (0.207 – 2.119)
	Score 3	0	0

Table 3: The logistic regression models after adjusting smoking status and periodontal health knowledge with age. In the left column, low-level treatment need was taken as the dependent factor and minimum treatment need as the reference category. In the right column, high-level need was taken as the dependent factor and low-level need as the reference category.

		Low-level treatment need Odds ratios (95% confidence limits)	**High-level treatment need Odds ratios (95% confidence limits)**
Age		1.099 (1.045 – 1.156)	1.039 (1.011 – 1.067)
Smoking status	Smoker		2.940 (1.636 – 5.282)
	Non-smoker		0
Periodontal health knowledge	Score 1	5.278 (1.657 – 16.817)	
	Score 2	5.683 (1.716 – 18 818)	
	Score 3	0	

in younger subjects. Almas *et al* (25) concluded that use of CPITN may be limited to the presence of gingival bleeding and pocket depth, but not to levels of plaque accumulation or gingivitis. Despite these criticisms, there are studies in the literature with successful use of CPITN in determining the periodontal treatment need in relatively large populations (26).

In the present study, the subjects living in urban regions brushed their teeth more than once a day compared to those living in rural regions. The reasons can vary; an urban population has better chances to receive dental treatment and education than rural people from a dentist. However, as we did not ask the annual number of dental visits to the participants, we cannot explain the difference by frequency of dentist visits. A higher education level or a higher income of subjects in urban areas than those living in rural areas cannot explain the difference, as education level did not statistically differ between numbers of daily tooth brushings.

One striking finding of the present study was that marriage was found to be associated with periodontal treatment needs. The underlying reason for this observation can be older age in married subjects than single ones. Persson *et al* (27) supposed that married elders show similar periodontal disease pattern with their spouses. According to their study, if one spouse had periodontitis, the other partner was likely to have periodontitis, and *vice versa*. Explanations for this phenomenon, at least in part, can be bacterial transmission and the fact that married couples share the same social factors and health habits (27, 28).

In the present study, periodontal health knowledge scores were higher and periodontal treatment need levels were lower in the subjects who brushed their teeth twice a

day or more, than those who brush less frequently. In the logistic regression analysis, it was also shown that age, marital status, and periodontal health knowledge were associated with low-level periodontal treatment need. High-level periodontal treatment need was associated with older age, smoking and the subjects being married. This suggests that good periodontal health knowledge is associated with low-level treatment need, while smoking is associated with high-level periodontal treatment need.

Smoking (risk factor) and age (risk determinant) are well-known and well-studied risks of periodontal diseases (29−31). However, the number of studies on periodontal health knowledge is limited. In a recent community level study, knowledge of periodontal health was found to be strongly associated with oral health behaviour (32). It is plausible that a subject's oral health behaviour can be the connective factor between periodontal health knowledge and periodontal treatment need. In several studies, it has been suggested that very young and senior age subjects had the lowest level of periodontal health knowledge (14, 32, 33). This is in line with our results, where we placed age and periodontal health knowledge in the same logistic regression model and got higher odds ratios for periodontal treatment need.

In conclusion, the results of this study showed that poor periodontal health knowledge is associated with low-level and smoking is associated with high-level periodontal treatment needs. Hence, it is possible to decrease community need for periodontal treatment with the elimination of acquired risk factors of periodontitis.

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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. Geneva: WHO; 2003.
2. Petersen PE, Bourgeois D, Ogawa H, Estupinan-Day S, Ndiaye C. The global burden of oral disease and risks to oral health. Bull World Health Organ 2005; **83:** 661−9.
3. Niigata University Graduate School of Medical and Dental Sciences. Periodontal country profile. An overview of CPITN data in the WHO Global Oral Data Bank. Available from: http://www.dent.niigata-u.ac.jp/prevent/perio/perio.html
4. Saydam G, Oktay Ý, Möller I. Türkiyede Aðýz Diþ Saðlýðý Durum Analizi. Dünya Saðlýk Örgütü Avrupa Bölgesi – Saðlýk Bakanlýðý, Ankara, 1990.
5. Gökalp S, Doðan BG, Tekçiçek M, Berberoðlu A, Ünlüer Þ. Eriþkin ve yaþlýda aðýz-diþ saðlýðý profile, Türkiye-2004. Hacettepe Diþheki Fak Derg 2007; **31:** 11−18.
6. Suominen-Taipale L, Nordblad A, Vehkalahti M, Aromaa A, eds. Oral health in the Finnish adult population. Health 2000 Survey. Helsinki: National Public Health Institute; 2008. Available from: http://www.terveys2000.fi/julkaisut/oral-health.pdf
7. Albandar JM. Epidemiology and risk factors of periodontal diseases. Dent Clin North Am 2005; **49:** 517−32.
8. Albandar JM. Global risk factors and risk indicators for periodontal diseases. Periodontol 2000 2002; **29:** 177−206.
9. Socransky SS, Haffajee AD. Periodontal microbial ecology. Periodontol 2000 2005; **38:** 135−87.
10. Cronin AJ, Claffey N, Stassen LF. Who is at risk? Periodontal disease risk analysis made accessible for the general dental practitioner. Br Dent J 2008; **205:** 131−7.
11. Klinge B, Norlund A. A socio-economic perspective on periodontal diseases: A systematic review. J Clin Periodontol 2005; **32** (**Suppl 6)**: 314−25.
12. Silversin J, Kornacki M. Controlling dental disease through prevention: Individual, institutional, and community dimensions. In: Cohen L, Bryant P, eds. Social sciences in dentistry: A critical bibliography. Vol II. London: Quintessence; 1984: 145−201.
13. Bader JD, Rozier RG, Mcfall WT Jr, Ramsey DL. Association of dental health knowledge with periodontal conditions among regular patients. Community Dent Oral Epidemiol 1990; **18:** 32−6.
14. El-Qaderi SS, Quteish Ta'ani D. Assessment of periodontal knowledge and periodontal status of an adult population in Jordan. Int J Dent Hyg 2004; **2:** 132−6.
15. Alwaeli HA, Al-Jundi SH. Periodontal disease awareness among pregnant women and its relationship with sociodemographic variables. Int J Dent Hyg 2005; **3:** 74−82.
16. 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; **32:** 281−91.
17. Ainamo J, Parviainen K, Murtomaa H. Reliability of the CPITN in the epidemiological assessment of periodontal treatment needs at 13−15 years of age. Int Dent J 1984; **34:** 214−8.
18. Cutress TW, Hunter PBV, Hoskins DIH. Comparison of the Periodontal Index (PI) and Community Periodontal Index of Treatment Needs (CPITN). Community Dent Oral Epidemiol 1986; **14:** 39−42.
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; **16:** 236−9.
20. Lewis JM, Morgan MV, Wright FAC. The validity of the CPITN scoring and presentation method for measuring periodontal conditions. J Clin Periodontol 1994; **21:** 1−6.
21. Inagaki K, Kurosu Y, Yoshinari N, Noguchi T, Krall EA, Garcia RI. Efficacy of periodontal disease and tooth loss to screen for low bone mineral density in Japanese women. Calcif Tissue Int 2005; **77:** 9−14. Epub 2005 Jul 14.
22. Blach A, Franek E, Witula A, Kolonko A, Chudek J, Drugacz J et al. The influence of chronic periodontitis on serum TNF-alpha, IL-6 and hs-CRP concentrations, and function of graft and survival of kidney transplant recipients. Clin Transplant 2009; **23:** 213−9. Epub 2009 Dec 16.
23. Baelum V, Manji F, Wanzala P, Fejerskov O. Relationship between CPITN and periodontal attachment loss findings in an adult population. J Clin Periodontol 1995; **22:** 146−52.
24. Holborow DW. The Community Periodontal Index of Treatment Needs – Uses and abuses? N Z Dent J 1998; **94:** 120−1.
25. Almas K, Bulman JS, Newman HN. Assessment of periodontal status with CPITN and conventional periodontal indices. J Clin Periodontol 1991; **18:** 654−9.
26. Katz J, Peretz B, Sgan-Cohen HD, Horev T, Eldad A. Periodontal status by CPITN, and associated variables in an Israeli permanent force military population. J Clin Periodontol 2000; **27:** 319−24.
27. Persson GR, Persson RE, Hollender LG, Kiyak HA. The impact of ethnicity, gender, and marital status on periodontal and systemic health of older subjects in the Trials to Enhance Elders' Teeth and Oral Health (TEETH). J Periodontol 2004; **75:** 817−23.
28. Asikainen S, Chen C, Slots J. Likelihood of transmitting actinobacillus actinomycetemcomitans and porphyromonas gingivalis in families with periodontitis. Oral Microbiol Immunol 1996; **11:** 387−94.

29. Calsina G, Ramón JM, Echeverría JJ. Effects of smoking on periodontal tissues. J Clin Periodontol 2002; **29:** 771−6.
30. Streckfus CF, Parsell DE, Streckfus JE, Pennington W, Johnson RB. Relationship between oral alveolar bone loss and ageing among African-American and Caucasian individuals. Gerontology 1999; **45:** 110−4.
31. Cronin AJ, Claffey N, Stassen LF. Who is at risk? Periodontal disease risk analysis made accessible for the general dental practitioner. Brit Dent J 2008; **205:** 131−7.
32. Deinzer R, Micheelis W, Granrath N, Hoffmann T. More to learn about: Periodontitis-related knowledge and its relationship with periodontal health behaviour. J Clin Periodontol 2009; **36:** 756−64.
33. Mårtensson C, Söderfeldt B, Andersson P, Halling A, Renvert S. Factors behind change in knowledge after a mass media campaign targeting periodontitis. Int J Dent Hyg 2006; **4:** 8−14.