Journal of
PERIODONTAL RESEARCH

J Periodont Res 2012; 47: 293–298

JOURNAL OF PERIODONTAL RESEARCH
doi:10.1111/j.1600-0765.2011.01431.x

The association between inflammatory bowel disease and periodontitis among Jordanians: a case–control study

R. A. Habashneh[1], Y. S. Khader[2], M. K. Alhumouz[1], K. Jadallah[3], Y. Ajlouni[4]

[1]Preventive Department, Faculty of Dentistry, Jordan University of Science and Technology, Irbid, Jordan, [2]Departments of Public Health, Community Medicine and Family Medicine, Jordan University of Science and Technology, Irbid, Jordan, [3]Division of Gastroenterology, Department of Internal Medicine, Faculty of Medicine, Jordan University of Science and Technology, Irbid, Jordan and [4]Department of Internal Medicine, Royal Medical Services, King Hussein Medical City, Jordan

Habashneh RA, Khader YS, Alhumouz MK, Jadallah K, Ajlouni Y. The association between inflammatory bowel disease and periodontitis among Jordanians: a case–control study. J Periodont Res 2012; 47: 293–298. © 2011 John Wiley & Sons A/S

Background and Objective: Inflammatory bowel disease (IBD) is hypothesized to involve immuno-inflammatory alterations, and the condition has been related to increased susceptibility to oral challenges. The objective of the study was to determine the association between the prevalence, severity and extent of periodontitis and both ulcerative colitis (UC) and Crohn's disease (CD).

Material and Methods: A case–control study was conducted among patients who attended outpatient clinics at King Hussein Medical City in Jordan during the study period. All participants completed the questionnaire and underwent thorough oral and periodontal examinations. Periodontitis was defined as presence of four or more teeth with one or more sites with probing pocket depth ≥ 4mm and clinical attachment level ≥ 3mm. The general linear model multivariate procedure and multivariate binary logistic regression were used to analyse the data.

Results: This case–control study included 260 Jordanian adults (101 with UC, 59 with CD and 100 with no IBD) with a mean (SD) age of 39.4 (0.7) years. The prevalence of periodontitis was much higher among patients with CD and those with UC compared with subjects having no IBD in the age groups < 36 and 36–45 years old only. After adjusting for age and number of missing teeth, patients with CD (odds ratio 4.9, 95% confidence interval 1.8–13.2) and patients with UC (odds ratio 7.00, 95% confidence interval 2.8–17.5) had significantly higher odds of periodontitis than subjects with no IBD. In multivariate analysis, the severity of periodontitis was significantly higher among patients with CD and patients with UC when compared with subjects having no IBD. Ulcerative colitis patients but not CD patients had significantly higher prevalence of deep ulcers in oral soft tissues than the non-IBD group ($p = 0.004$).

Conclusion: Patients with IBD have higher prevalence, severity and extent of periodontitis compared with those having no IBD.

Dr Rola Al Habashneh, MPH, MS, ABP, Preventive Department – Periodontics, Faculty of Dentistry, Jordan University of Science and Technology, PO Box 3030, Irbid 22110, Jordan
Tel: 009622796064813
Fax: 0096227278962
e-mail: rolaperio@yahoo.com

Key words: Crohn's disease; periodontitis; ulcerative colitis

Accepted for publication September 27, 2011

Inflammatory bowel disease (IBD), a significant health problem all over the world, comprises two chronic relapsing inflammatory disorders of the gastrointestinal tract: ulcerative colitis (UC) and Crohn's disease (CD; 1). Ulcerative colitis affects only the large bowel, whereas CD can affect any part of the gastrointestinal tract. The onset of the disease is usually between 15 and 30 years, but both younger and older individuals may be affected (2,3). Epidemiological studies suggest a widely varying incidence of IBD, with highest rates of UC and CD reported in Northern Europe and North America (2–5). The incidence of CD in the USA has been estimated at between 6 and 8 per 100,000, with prevalence between 130 and 200 per 100,000 (5,6). In Jordan, UC is not rare and occurs among all age groups, with a peak incidence in the second and third decades (7). Multiple systemic factors influence the progression of IBD, including genetic factors, inflammatory mediators, bacterial infection and smoking. Several of these are also risk factors for periodontitis (8–13). In addition, studies have shown that the progression of disease in both IBD and periodontitis may be due to nonspecific responses of the anti- and proinflammatory cytokines (11–14).

Several studies have demonstrated that oral changes occur in patients with IBD (15–22). Inflammatory bowel disease has also been associated with persistent oral lesions in pediatric populations (23). The epidemiological association between IBD and periodontitis is still controversial. One study reported an approximately 12% higher prevalence of periodontitis in IBD patients compared with a previous survey on a US population (20). However, Grössner-Schreiber *et al.* (21) found that IBD was significantly associated with increased risk for dental caries but not periodontitis. Given the limited amount of information regarding periodontal conditions in IBD patients, the determination of periodontal status through cross-sectional and longitudinal studies is needed. In addition, a possible common underlying mechanism would contribute to better understanding of the relationship of IBD and periodontitis. Therefore, the present study was conducted to determine the association between prevalence, severity and extent of periodontitis and both UC and CD.

Methods

Participants

This study was approved by the Institutional Review Board of Jordan University of Science and Technology. Outpatients with IBD aged 18 years and above who attended the Department of General Internal Medicine at King Hussein Medical City from April 2009 to November 2009 were invited to participate in this study. Patients were included if they were diagnosed with IBD at least 1 year before the start of the study. The diagnosis of IBD was established by clinical, radiological, endoscopic and histological criteria. Patients with a history of a systemic condition or medication use that might influence the severity of periodontitis were excluded (i.e. patients with a history of diabetes mellitus, thyroid diseases, chronic renal problems and connective tissue diseases). Pregnant women and patients who were edentulous and those who had undergone periodontal treatment within the preceding 6 months were also excluded.

A total of 231 IBD patients visited the clinic during the study period. Of these, 187 patients met the inclusion criteria. Although the initial plan was to select 100 patients with UC and 100 patients with CD, only 160 patients (82.0%) with IBD (101 with UC and 59 with CD) attended the hospital during the study period and agreed to participate in the study. A sample of 100 control participants aged 18 years or above who exhibited no clinical signs of IBD was selected from patients who attended the emergency clinics for minor illnesses in the same hospital and during the study period. In every other working day during the study period, the researcher visited the emergency clinic and selected the first available patient (one patient per day) aged 18 years or above to be included as a control subject. The researchers continued to recruit patients until they reached a sample of 100 control subjects.

Data collection

After informed consent had been obtained, eligible patients were referred to the dental clinic for an interview and periodontal examination. The questionnaire sought information about age, sex, education level, occupation, smoking habits, medical history, oral hygiene behaviors, years since IBD was first diagnosed and types of medication used.

Data regarding changes in food habits, such as the type of food the patient had to avoid because of problems in patient's teeth or mouth since the beginning of the disease, the changes in frequency and amount of food, dry mouth, acid reflux, vomiting, nausea, acidic taste and burning sensation, were also obtained.

Periodontal clinical examination

The clinical examination included a full-mouth periodontal assessment. Probing pocket depth and clinical attachment level were measured at six sites (mesial, distal and middle sites of the buccal and lingual sides) on each tooth using a Williams's periodontal probe. Clinical attachment level was measured as the distance from the cemento-enamel junction to the base of the pocket. The percentage of sites with bleeding on probing was calculated. Third molars were excluded from the examination. Periodontitis was defined as presence of four or more teeth with one site or more having a probing pocket depth ≥ 4 mm and clinical attachment level ≥ 3 mm (24). Furthermore, plaque index (25), gingival index (26) and calculus index (presence or absence) were assessed. These parameters were evaluated at four sites on each tooth (mesial, distal, buccal and lingual).

Clinical examinations were done by one skilled examiner (M.K.AH). Prior to the beginning of this study, measurement reliability was determined, based on duplicate examinations performed on 10 patients, 1 wk apart. Of the replications, 98% were within 1 mm for probing pocket depth and 96% were within 1 mm for clinical attachment level.

Statistical analysis

The Statistical Package for Social Sciences software (SPSS, version 15, Chicago, IL, USA) was used for data processing and analysis. The subjects' variables were described using frequency distribution for categorical variables and mean and standard deviation for continuous variables. Chi-squared test was used to test the differences in the socio-demographic, oral hygiene and relevant characteristics between participants according to their disease status. The differences in the prevalence rates of periodontitis between the disease groups were analysed using Chi-squared test. The differences in the periodontal parameters between patients with UC, patients with CD and patients without IBD were analysed using the general linear model multivariate procedure. This procedure provides regression analysis and analysis of variance for multiple dependent variables (periodontal and dental parameters) by different explanatory variables. In this analysis, all periodontal parameters, including average gingival index, average probing pocket depth, average clinical attachment level, average gingival recession and percentage of surfaces with probing pocket depth ≥ 3 mm, probing pocket depth ≥ 4 mm, clinical attachment level ≥ 3 mm and clinical attachment level ≥ 4 mm were treated as dependent variables in the same general linear model that adjusted for age, plaque index and number of missing teeth. Multivariate binary logistic regression was used to determine the association between IBD (independent variable) and periodontitis (dependent variable) after adjusting for important variables. Forward selection (likelihood ratio) method was used to select the independent important variables, including age, sex, education level, occupation, smoking habits, medical history, oral hygiene behaviors and number of missing teeth. In the last model, only IBD, age and number of missing teeth were associated with periodontitis. After a logistic regression model had been fitted, a test of goodness of fit of the resulting model was performed using the deviance and Pearson's chi-squared goodness of fit test statistics. Adjusted odds ratios and their 95% confidence intervals are reported. A p-value < 0.05 was considered statistically significant.

Results

Participants' characteristics

This study included 260 Jordanian adults (101 with UC, 59 with CD and 100 with no IBD), with a mean age of 39.4 ± 0.7 years. The socio-demographic and relevant characteristics of the participants according to disease status are shown in Table 1. About 55.9% of CD patients, 60.4% of UC patients and 62.0% of the non-IBD group were men. More than half of the participants (61.0% of CD patients, 66.3% of UC patients and 53.0% of the non-IBD group) had less than a university-level education. About 18.1% of the IBD group and 24.0% of the non-IBD group reported that they did not brush their teeth. Patients in the three groups were not significantly different in age, sex, education and oral hygiene habits. Patients with UC were more likely to be ex-smokers.

Regarding change in food habits, 89.9% of CD and 69.3% of UC patients avoided some foods, 75.0% of CD patients avoided milk products, 96.2% of CD and 93.1% of UC patients avoided sweet and sugary foods, 93.8% of CD and 76.8% of UC patients had decreased the size of meals, while 91.7% of CD and 76.5% of UC patients had to increase the frequency of meals.

Periodontal status of participants

The periodontal clinical features of the subject groups are presented in Table 2. The average plaque index and average gingival index in patients with UC and patients with CD were significantly higher than those in subjects with no IBD. The two IBD groups did not differ significantly in the average plaque index and average gingival index. The average gingival recession was significantly higher for those with UC (0.86) compared with those having CD (0.53; $p = 0.007$) and with those having no IBD (0.44; $p \leq 0.005$). The severity of periodontitis, as measured by the average probing pocket depth and average clinical attachment level, was significantly greater among UC patients compared with CD patients and subjects with no IBD. In contrast, the extent of the periodontitis as measured by the percentage of sites with clinical attachment level ≥ 4 mm was significantly higher among patients with UC (26.65) and patients with CD (21.25) compared with those having no IBD (9.00).

Overall, there was no significant difference in the prevalence of periodontitis between the three groups. In the stratified analysis, the prevalence of periodontitis was much higher among patients with CD and those with UC compared with subject without IBD in the age groups < 36 and 36–45 years old only (Table 3). The difference in the prevalence of periodontitis between the three groups was not significant in the > 45 years of age group.

In multivariate analysis (Table 4), after adjusting for age and number of missing teeth, patients with CD (odds ratio 4.9, 95% confidence interval 1.8–13.2) and patients with UC (odds ratio 7.0, 95% confidence interval 2.8–17.5) had significantly higher odds of periodontitis than subjects with no IBD. Patients with CD and patients with UC were not significantly different in the odds of periodontitis.

Discussion

This study showed a positive association between periodontitis and UC and CD. Periodontitis in IBD patients, and especially in UC patients, was more generalized and more severe than in the non-IBD group. Our results are in agreement with other researchers (20,22,27), who showed a higher prevalence but moderate severity of periodontitis in patients with CD and UC. To the best of our knowledge, this is the first study to investigate the association between periodontitis and inflammatory bowel disease in the Eastern Mediterranean region. In our study, the average gingival recession was significantly higher for those with UC compared with those having CD

Table 1. Socio-demographic, oral hygiene and relevant characteristics of participants according to disease status

Variable	Crohn's disease (n = 59) n (%)	Ulcerative colitis (n = 101) n (%)	No IBD (n = 100) n (%)	Total (n = 260) n (%)	p-value*
Age (years)					
< 36	24 (40.7)	39 (38.6)	39 (39.0)	102 (39.2)	0.980
36–45	21 (35.6)	36 (35.6)	33 (33.0)	90 (34.6)	
> 45	14 (23.7)	26 (25.7)	28 (28.0)	68 (26.2)	
Sex					
Male	33 (55.9)	61 (60.4)	62 (62.0)	156 (60.0)	0.748
Female	26 (44.1)	40 (39.6)	38 (38.0)	104 (40.0)	
Patient education					
Less than university	36 (61.0)	67 (66.3)	53 (53.0)	156 (60.0)	0.153
University or more	23 (39.0)	34 (33.7)	47 (47.0)	104 (40.0)	
Smoking					
Nonsmoker	23 (39.0)	55 (54.5)	44 (44.0)	122 (46.9)	< 0.005
Current smoker	31 (52.5)	17 (16.8)	49 (49.0)	97 (37.3)	
Ex-smoker	5 (8.5)	29 (28.7)	7 (7.0)	41 (15.8)	
Hypertension	5 (8.5)	13 (12.9)	7 (7.0)	25 (9.6)	0.349
Tooth brushing					
No brushing	9 (15.3)	20 (19.8)	24 (24.0)	53 (20.4)	0.486
Occasional brushing	27 (45.8)	42 (41.6)	47 (47.0)	116 (44.6)	
Regular brushing	23 (39.0)	39 (38.6)	29 (29.0)	91 (35.0)	
Last dental visit					
< 6 months ago	20 (33.9)	30 (29.7)	37 (37.0)	87 (33.5)	0.592
6–12 months ago	9 (15.3)	10 (9.9)	14 (14.0)	33 (12.7)	
> 12 months ago	27 (45.8	55 (54.5)	47 (47.0)	129 (49.6)	
None	3 (5.1)	6 (5.9)	2 (2.0)	11 (4.2)	

Abbreviation: IBD, inflammatory bowel disease.
* Chi-squared test.

(p = 0.007) and with those without IBD (p = < 0.005), which highlights the increased chance for tissue loss among these patients. Such results agree with Steinn *et al.* (27), who showed minimal recession among CD patients. When comparing the two IBD groups, it was observed that the severity and extent of periodontitis were different. However, the two groups did not differ in average plaque index and average gingival. This difference may indicate a potential difference in the pathophysiology of these two diseases. Proposed mechanisms to explain a potential relationship between periodontitis and IBD have been summarized by Indriolo *et al.* (8). This association could be, at least in part, due to common predisposing factors that make subjects more prone to both, such as age and genetic predisposition, as well as environmental or lifestyle factors. Confounding factors, such as socio-economic status and smoking, also make it difficult to establish whether or not there is a

Table 2. The multivariate analysis of severity and extent of periodontitis and dental parameters according to disease status

Variable	(A) Crohn's disease Mean (SD)	(B) Ulcerative colitis Mean(SD)	(C) No IBD Mean (SD)	Pairwise comparisons
Average				
Plaque index*	2.32 (0.70)	2.51 (0.52)	1.98 (0.58)	A vs. C/B vs. C
Gingival index	2.32 (0.70)	2.41 (0.65)	1.44 (0.68)	A vs. C/B vs. C
Probing pocket depth	1.29 (0.47)	1.51 (0.47)	1.25 (0.37)	A vs. B/B vs. C
Clinical attachment level	1.95 (0.98)	2.36 (1.13)	1.70 (0.89)	A vs. B/B vs. C
Gingival recession	0.53 (0.55)	0.86 (0.72)	0.44 (0.60)	A vs. B/B vs. C
Percentage of sites with				
Probing pocket depth ≥ 3 mm	10.40 (16.0)	1.40 (14.10)	4.85 (8.70)	A vs. C/B vs. C
Probing pocket depth ≥ 4 mm	0.08 (0.60)	0.26 (1.54)	0.35 (1.95)	NS
Clinical attachment level ≥ 3 mm	31.60 (34.46)	43.30 (38.80)	25.50 (33.40)	B vs. C
Clinical attachment level ≥ 4 mm	21.25 (27.30)	26.65 (29.75)	9.00 (14.0)	A vs. C/B vs. C
Clinical attachment level ≥ 5 mm	0.38 (8.30)	5.90 (13.70)	0.35 (1.76)	B vs. C
Bleeding on probing	10.84 (16.20)	10.20 (14.25)	4.70 (8.30)	A vs. C/B vs. C

All other periodontal parameters were adjusted for age, plaque index and number of missing teeth.
* Adjusted for age and number of missing teeth.

Table 3. Prevalence of periodontitis among patients with Crohn's disease, ulcerative colitis and non-IBD group stratified by age group

Variable	Crohn's disease (n = 59) n (%)	Ulcerative colitis (n = 101) n (%)	No IBD (n = 100) n (%)	Total (n = 260) n (%)	p-value*
Age (years)					
< 36	6 (25.0)	5 (12.8)	1 (2.6)	12 (11.8)	0.026
36–45	15 (71.4)	30 (83.3)	14 (42.4)	59 (65.6)	0.001
> 45	11 (78.6)	26 (100.0)	25 (89.3)	62 (91.2)	0.067

* Chi-squared test for the differences between proportions in each age group.

Table 4. Multivariate logistic regression analysis of the difference in prevalence of periodontitis between disease groups

Variable	Odds ratio (95% confidence interval)	p-value
Group		
Crohn's disease	4.92 (1.8–13.2)	0.002
Ulcerative colitis	7.00 (2.8–17.5)	< 0.005
Healthy (no IBD)	1	
Number of missing teeth	1.31 (1.1–1.5)	0.001
Age (years)	1.24 (1.17–1.32)	< 0.005

causal relationship between IBD and periodontitis. Few studies (28,29) have demonstrated that the biological activity of a variety of cytokines may be directly relevant to periodontal destruction. Also, a high frequency of periodontopathic bacteria may play a key role, as asserted by Stein *et al*. (27), who found large numbers of *Campylobacter rectus*, *Porphyromonas gingivalis* and *Tannerella forsythia* among CD patients. In fact, it is more useful to study the mechanisms by which the two IBD diseases may be associated with periodontitis.

Regarding food habits, our results were similar to those reported in two other studies that evaluated the nutritional status of patients with CD and found an increased intake of refined carbohydrates compared with normal control subjects (30,31). We were unable to find any significant differences in the prevalence of oral changes, such as cobblestone appearance of the mucosa, swelling of the oral and perioral tissues, angular cheilitis and pyostomatitis vegetans, similar to Brito *et al*. (22).

One of the strengths of our study was the use of a control group of individuals who were demographically similar to the patients with IBD. We were also able to control for the most important potential confounders of the relationship between IBD and periodontal disease, which include age, plaque index and number of missing teeth. Given the study design we used, our findings reflect the cumulative effects of disease processes and limit our ability to suggest causal relationships. Furthermore, one has to be cautious when interpreting the findings of the multivariate analysis because of the small sample size, especially the low number of patients with CD. The effect of the small sample size on the estimate of the associations in the multivariate analysis resulted in wide confidence intervals for the odds ratios.

In conclusion, patients with IBD had increased odds of having periodontitis compared with subjects without IBD. Longitudinal studies would be valuable in establishing a temporal association between IBD and periodontitis. In order to better understand the relationship between these two diseases, future longitudinal studies on immuno-inflammatory, common risk factors and genetic markers between the IBD and periodontitis are warranted. Dental professionals and gastroenterologists should understand the potential relationship between IBD and periodontitis, and educate IBD patients on their periodontitis risk and the importance of proper oral hygiene.

Acknowledgements

The authors thank the staff in King Hussein Hospital in Jordan for their help and support. This study was supported by the University of Science and Technology/Deanship of Research Fund.

References

1. Farrokhyar F, Swarbrick ET, Irvine EJ. A critical review of Epidemiological studies in inflammatory bowel disease. *Scand J Gastroenterol* 2001;**36:**2–15.
2. Shivananda S, Lennard-Jones J, Logan R *et al*. Incidence of inflammatory bowel disease across Europe: is there a difference between north and south? Results of the European Collaborative Study on Inflammatory Bowel Disease (EC-IBD) *Gut* 1996;**39:**690–697.
3. Bernstein CN, Blanchard JF, Rawsthorne P, Wajda A. Epidemiology of Crohn's disease and ulcerative colitis in a central Canadian province: a population-based study. *Am J Epidemiol* 1999;**149:**916–924.
4. Loftus CG, Loftus EV Jr, Harmsen WS *et al*. Update on the incidence and prevalence of Crohn's disease and ulcerative colitis in Olmsted County, Minnesota, 1940–2000. *Inflamm Bowel Dis* 2007;**13:** 254–261.
5. Kappelman MD, Rifas-Shiman SL, Kleinman K *et al*. The prevalence and geographic distribution of Crohn's disease and ulcerative colitis in the United States. *Clin Gastroenterol Hepatol* 2007;**5:**1424–1429.

6. Herrington LJ, Liu L, Lewis JD *et al*. Incidence and prevalence of inflamatory bowel disease in a Northern California managed care organization, 1996–2002. *Am J Gastroenterol* 2008;**103:**1998–2006.
7. Ghazzawe E, Al-Mrayat Z. Review of chronic ulcerative colitis cases at King Hussein Medical Centre, Jordan. *East Mediterr Health J* 2007;**13:**249–300.
8. Indriolo A, Greco S, Ravelli P, Fagiuoli S. What can we learn about biofilm/host interactions from the study of inflammatory bowel disease. *J Clin Periodontol* 2011;**38**(Suppl 11)**:**36–43.
9. McDonald JS. Oral lesions in Crohn's disease: report of two cases and update of the literature. *Oral Surg* 1978;**46:** 234–244.
10. Bouma G, Strobe W. The immunological and genetic basis of inflammatory bowel disease. *Nat Rev Immunol* 2003;**3:**521–533.
11. Kinane DF, Mark Bartold P. Clinical relevance of the host responses of periodontitis. *Periodontol 2000* 2007;**43:**278–293.
12. Pallone F, Monteleone G. Mechanisms of tissue damage in inflammatory bowel disease. *Curr Opin Gastroenterol* 2001;**17:** 307–312.
13. Brandtzaeg P. Inflammatory bowel disease: clinics and pathology. Do inflammatory bowel disease and periodontal disease have similar immunopathogeneses? *Acta Odontol Scand* 2001;**59:**235–243.
14. Figueredo CM, Brito F, Barros FC *et al*. Expression of cytokines in the gingival crevicular fluid and serum from patients with inflammatory bowel disease and untreated chronic periodontitis. *J Periodont Res* 2011;**46:**141–146.
15. Lamster I, Sonis S, Hannigan A, Kolodkin A. An association between Crohn's disease, periodontal disease and enhanced neutrophil function. *J Periodontol* 1978; **49:**475–479.
16. Clark RA, Page RC, Wilde G. Defective neutrophil chemotaxis in juvenile periodontitis. *Infect Immun* 1977;**18:**694–700.
17. Lavine WS, Maderazo EG, Stolman J *et al*. Impaired neutrophil chemotaxis in patients with juvenile and rapidly progressing periodontitis. *J Periodontal Res* 1979;**14:**10–19.
18. Engel LD, Pasquinelli KL, Leone SA, Moncla BJ, Nielson KD, Rabinovitch PS. Abnormal lymphocyte profiles and leukotriene B4 status in a patient with Crohn's disease and severe periodontitis. *J Periodontol* 1988;**59:**841–847.
19. Van Dyke TE, Dowell VR, Offenbacher S, Snyder W, Hersh T. Potential role of microorganisms isolated from periodontal lesions in the pathogenesis of inflammatory bowel disease. *Infect Immu* 1986;**53:** 671–677.
20. Flemmig TF, Shanahan F, Miyasaki KT. Prevalence and severity of periodontal disease in patients with inflammatory bowel disease. *J Clin Periodontol* 1991;**18:** 690–697.
21. Grössner-Schreiber B, Fetter T, Hedderich J, Kocher T, Schreiber S, Jepsen S. Prevalence of dental caries and periodontal disease in patients with inflammatory bowel disease: a case–control study. *J Clin Peridontol* 2006;**33:**478–484.
22. Brito F, de Barros FC, Zaltman C *et al*. Prevalence of periodontitis and DMFT index in patients with Crohn's disease and ulcerative colitis. *J Clin Periodontol* 2008; **35:**555–560.
23. Galbraith SS, Drolet BA, Kugathasan S, Paller AS, Esterly NB. Asymptomatic inflammatory bowel disease presenting with mucocutaneous findings. *Pediatrics* 2005;**116:**e439–e444.
24. Oliver RC, Brown LJ, Löe H. Periodontal diseases in the United States population. *J Periodontol* 1998;**69:**269–278.
25. Silness J, Loe H. Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition. *Acta Odontol Scand* 1964;**22:**121–135.
26. Löe H. The gingival index, the plaque index and the retention index systems. *J Periodontol* 1967;**38:**610–616.
27. Stein JM, Lammert F, Zimmer V *et al*. Clinical Periodontal and Microbiologic Parameters in Patients With Crohn's Disease With Consideration of the CARD15 Genotype. *J Periodontol* 2010; **81:**535–545.
28. McGee JM, Tucci MA, Edmundson TP, Serio CL, Johnson RB. The relationship between concentrations of proinflammatory cytokines within gingiva and the adjacent sulcular depth. *J Periodontol* 1998;**69:**865–871.
29. Yucel-Lindberg T, Nilsson S, Modeer T. Signal transduction pathways involved in the synergistic stimulation of prostaglandin production by interleukin-1b and tumor necrosis factor α in human gingival fibroblast. *J Dent Res* 1999;**78:** 61–68.
30. Martini GA, Brandes JW. Increased consumption of refined carbohydrates in patients with Crohn's disease. *Klin Wochenschr* 1976;**54:**367.
31. Kasper H, Sommer H. Dietary fiber and nutrient in Crohn's disease. *Am J Clin Nutr* 1979;**32:**1898.