Oral Hygiene in Children with Type I *Diabetes Mellitus*

Jolanta Siudikienė, Vita Mačiulskienė, Rimantė Dobrovolskienė, Irena Nedzelskienė

SUMMARY

Oral hygiene is an important etiological factor related to oral health status in children. The aim of the study was to evaluate the oral hygiene status in children with type I diabetes mellitus (DM) and in their non-diabetic controls, and to correlate it with the health condition of the gingival tissues. Materials and methods: seventy 10-15 year-old children (mean age13.6, SD=1.6) with type I DM and 70 their age and sex-matched non-diabetic controls were included in the study. The metabolic control of DM was categorized into well- to- moderately controlled and poorly-controlled diabetes groups based on glycosylated haemoglobin HbA1c. The oral hygiene and gingival status were assessed using the Simplified Oral hygiene index OHI-S (Greene-Vermillion) and gingival index GI (Löe-Silness), respectively. Student's t, Mann-Whitney U or chi-square tests and linear regression were used in the statistical analyses. Results: there were no statistically significant differences in the mean values of OHI-S between the diabetics and non-diabetics, however the mean calculus index (CI-S) was significantly higher and the mean plaque index (DI-S) was significantly lower in diabetic subjects than non- diabetics (p<0.05). The children with type I DM had significantly higher mean values of GI compared with the non-diabetic subjects (0.15, SD=0.37 and 0.05, SD=0.19 respectively) (p<0.05). Healthy gingiva was recorded in 73% diabetics, and 87% of the non-diabetics (p<0.05). The poorly controlled diabetics had higher mean gingival, plaque, calculus indices than well-moderately controlled subjects, although the differences were not statistically significant. Statistically significantly higher mean OHI-S index was found in children with poor control of diabetes compared with the well-moderately- controlled diabetics (1.39, SD=0.75 and 1.07, SD=0.53, respectively) (p<0.05). The level of gingivitis statistically significantly correlated with the levels of calculus in both study groups (p<0.001). No difference in toothbrushing habits was revealed between the study subjects. Conclusion: Despite similar oral hygiene habits, the children with type I DM were more prone to calculus accumulation which seemed to be a predisposing factor in development of gingivitis in these individuals.

Key words: plaque index, calculus, gingivitis, type I diabetes mellitus, children.

INTRODUCTION

Bacterial dental plaque is considered to be the primary etiological factor in the development of dental caries and gingivitis [1, 2]. Since the level of individual oral hygiene is directly related to the amount of plaque build up on the teeth, it is reasonable to predict that the level of oral hygiene in a population is positively correlated with the prevalence and severity of periodontal diseases and dental caries [3, 4].

The influence of type I diabetes mellitus (DM) on oral health has been thoroughly studied. There is no hard evidence that diabetic individuals are more prone to the risk of dental caries and periodontal diseases. Numerous studies showed that individuals with diabetes mellitus had an increased rate of dental caries [5-7] and gingivitis [8-10] as well as diabetics had higher dental plaque indices [8, 11] compared with non-diabetic controls, although some workers did not find significant differences in clinical periodontal parameters between the insulin dependent juvenile diabetics and their non-diabetic siblings [12]. Furthermore, diabetic children were shown to have more gingival inflammation than children without diabetes, in spite of similar plaque scores [13, 14].

It has is been stated that diabetes mellitus as such does not cause gingivitis or periodontal pockets, but there are indications that it alters the response of the periodontal tissues to local factors [15]. One of the predisposing local factors related with the development and progression of gingival inflammation could be dental calculus [2]. It has been demonstrated that in diabetic patients more calculus was detected than in their controls [16].

The aim of the study was to evaluate the oral hygiene status in children with type I diabetes mellitus and in their non-diabetic controls, and to correlate it with the health condition of the gingival tissues.

MATERIAL AND METHODS

A total of 140 10–15-year-old children (mean age13.6, SD=1.61) living in Kaunas city and the region participated in the study. The test group comprised 70 children with type I DM registered in the National Childhood Diabetes Register. The pediatrician-endocrinologist evaluated the metabolic control of diabetes and the development of complications at the Department of the Childhood Endocrinology at Kaunas University of Medicine. The level of the metabolic control of diabetes mellitus was determined by the glycosylated haemoglobin HbA1c (analyzator DC-2000, Bayer, Germany), which reflects the average of blood glucose balance during the past 2-3 months. The group was divided in two sub-groups: well- to- moderately controlled (HbA1c≤8.9%) and poorly-controlled (HbA1c≥9.0%) diabetes [17]. The control group comprised 70 age and sex-matched non-diabetic controls without any systemic diseases and medications.

The oral hygiene status of the study participants was assessed using the Simplified Oral hygiene index OHI-S (

[1]Clinic of Dental and Oral Diseases, Faculty of Odontology, Kaunas University of Medicine, Lithuania
[2]Clinic of Endocrinology, Kaunas University of Medicine.
Jolanta Siudikienė[1] - D.D.S.
Vita Mačiulskienė[1] - D.D.S., PhD, assoc. prof.
Rimantė Dobrovolskienė[2] - M.D.
Irena Nedzelskienė[1] - biostatistitian.

Address correspondence to Jolanta Siudikienė: Clinic of Dental and Oral Diseases, Faculty of Odontology, Kaunas University of Medicine, Eiveniu Str. 2, Kaunas LT-3007, Lithuania.
E-mail: jolantasiu@hotmail.com

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Table 1. The description of the criteria for oral hygiene and gingiva health status evaluation.

Score	Criteria		
	DI-S	CI-S	GI
0	No debris or stain present.	No calculus present.	Normal gingiva.
1	Soft debris covering not more than 1/3 of the tooth surface.	Supragingival calculus covering not more than 1/3 of the tooth surface.	Mild inflammation: slight change in color and slight edema. No bleeding on probing.
2	Soft debris covering more than 1/3, but not more than 2/3 of the tooth surface.	Supragingival calculus covering more than 1/3 of the tooth surface, or the presence of individual flecks of subgingival calculus around the tooth cervix.	Mild inflammation: slight change in color and slight edema. No bleeding on probing.
3	Soft debris covering more than 2/3 of the tooth surface.	Supragingival calculus covering more than 2/3 of the tooth surface, or continuous heavy band of subgingival calculus around the tooth cervix.	Severe inflammation: marked redness and edema. Ulceration. Tendency toward spontaneous bleeding.

Simplified Debris (plaque) Index DI-S and Simplified Calculus Index CI-S) as described by Greene-Vermillion (1967) [18].

The criteria for determination of DI-S and CI-S are presented in the Table 1.

The individual DI-S and CI-S were calculated by adding the scores for six different tooth surfaces together and dividing by the number of teeth examined.

Nominal scale for evaluation of DI-S and CI-S was: Exellent – 0; Good - 0.1-0.6; Fair –0.7-1.8; Poor – 1.9-3.0. Added together the DI-S and the CI-S scores gave the total OHI-S index. Nominal scale for evaluation of OHI-S was: Exellent - 0; Good - 0.1-1.2; Fair –1.3-3.0; Poor - 3.1-6.0 [19].

The gingival health of the study participants was assessed using the gingival index GI as described by Löe-Silness (1963) [20]. Each of four gingival areas of all permanent teeth (facial, mesial, distal, and lingual) was assessed for inflammation. The scores for four areas of the tooth were added and divided by four to give a tooth score. By adding the tooth scores together and dividing by the number of teeth examined, an individual's GI score was obtained. The criteria for GI evaluation are presented in Table 1. Nominal scale for evaluation of GI was: 0- Healthy gingiva; Mild inflammation-0.1-1.0; Moderate inflammation- 1.1-2.0; Severe inflammation-2.1-3.0 [21].

All study participants were interviewed about their oral hygiene habits such as frequency of toothbrushing, using dental floss, frequency of dental visits.

The study protocol was approved by the Ethical Committee of Kaunas University of Medicine, Kaunas, Lithuania. Informed consent was obtained from the parents of all participants of the study.

STATISTICAL ANALYSIS

The study results were expressed by mean values and standard deviations (SD). Statistical significances of differences between the study groups were assessed by Student's t test. Frequencies were compared by using chi-square test for cross tables. In addition, the data were checked for normal distribution by Kolmogorov-Smirnov test, and the differences between the groups were assessed by using nonparametric Mann-Whitney U test. The linear regression (Pearson's correlation, r) with 95% confidence interval were calculated between the selected study parameters. P-values less than 0.05 were considered statistically significant. The data were analyzed using an SPSS (version 12.1.) statistical program package.

RESULTS

The results showed moderate oral hygiene status in both study groups. There were no statistically significant differences in the mean values of OHI-S between the diabetics and non-diabetics, although significantly higher mean DI-S index was recorded in the non-diabetic group than in
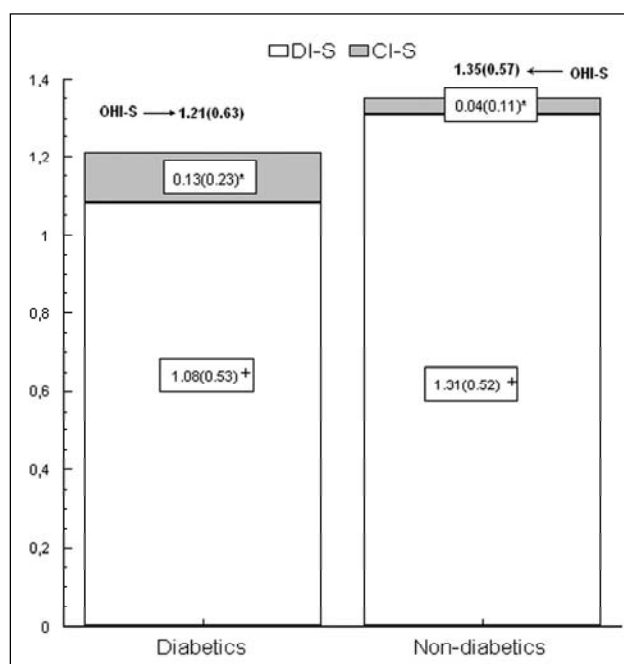

Figure 1. The oral hygiene levels in diabetic and non-diabetic children.
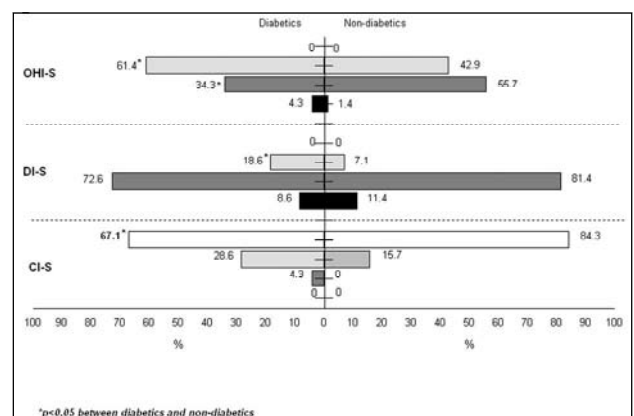

Figure 2. The distribution of the OHI-S, DI-S and CI-S indexes in the diabetic and non-diabetic children.

the children with type I DM (p<0.05). In contrast, the diabetic subjects had significantly more calculus than the non-diabetics (p<0.05) (Figure 1). The distribution of the OHI-S values showed that 61% of the diabetic subjects and 43% of the non-diabetic controls had good evaluation of the oral hygiene (p<0.05) (Figure 2). Only 4% diabetics and 1% controls were evaluated as having poor oral hygiene. Most of the study participants (73% diabetics and 81% non-diabetics) had a fair evaluation of the plaque index (DI-S) and significantly less non-diabetic children had good evaluation of the plaque index (DI-S) compared to the diabetics (Figure 2). Analysis of CI-S index distribution in the study population demonstrated that statistically significantly less diabetic children were calculus free compared with the non-diabetics (67% and 84%, respectively) (p<0.05) (Figure 2).

Analysis of the data of gingival health in the study groups showed that the diabetic children had significantly higher means of the gingival index compared with the non-diabetic subjects. The mean value of GI was 0.15, SD=0.37 in the children with type I DM and 0.05, SD=0.19 in the non-diabetic controls, respectively (p<0.05). Healthy gingiva was recorded in 87% of the non-diabetic children, and 73% of the diabetics (p<0.05) (Figure 3). Mild and moderate forms of gingivitis were more expressed in the patients with diabetes (27%) than in the non-diabetic subjects (13%) (p<0.05).

The higher mean GI values were determined in the diabetic children with poor metabolic control of diabetes than in well-moderately controlled diabetics, although the differences were not statistically significant (the mean GI were 0.23, SD=0.49 and 0.08, SD=0.21, respectively). The same tendency was observed when analyzing plaque (debris) and calculus indices among the diabetics: the mean of CI-S values were 0.09, SD=0.15 in well-moderately- controlled, and 0.18, SD=0.29 in poorly- controlled diabetics, respectively; the mean of DI-S values were: 0.98, SD=0.47 in well- moderately- controlled and 1.22, SD=0.57 in poorly-controlled diabetics, respectively. However, the poorly controlled diabetics had statistically significantly higher mean OHI-S values than the well-moderately- controlled diabetics (the mean

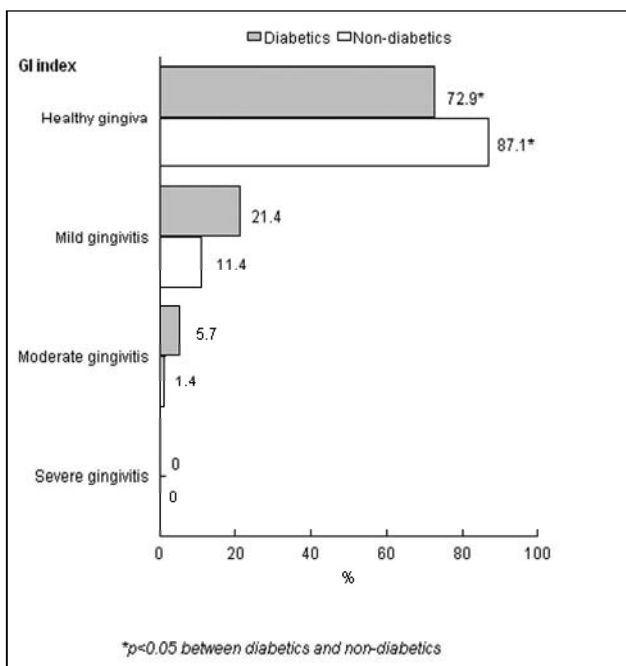OHI-S were 1.07, SD=0.53 in well-moderately- controlled, and 1.39, SD=0.75 in poorly- controlled diabetics, respectively) (p<0.05). The level of gingivitis (GI) statistically significantly correlated with calculus (CI-S) levels in both study groups (r=0.82, p<0.001) (Figure 4).

Analysis of the questionnaire as regards oral hygiene habits showed that the majority of the study participants brushed their teeth once or twice a day: (86 % diabetics and 94% non-diabetics). However, most of the children reported that they never used dental floss (70% diabetics and 86% non-diabetics, respectively (p<0.05)). The study groups did not differ with respect to dental visits during last year.

DISCUSSION

The lack of correlation in diabetic children between periodontal health and the presence of plaque on teeth surfaces has been extensively discussed in the literature (for review, see Iughetti L et al., 1999) [22]. Still, many studies indicated significantly higher mean plaque scores [8, 11, 23, 24], more calculus [16, 25] and higher gingivitis indices [5, 26, 27] in diabetics than in non-diabetic controls. The results of present study showed no statistically significant differences in the oral hygiene levels between the diabetic and non-diabetic children. However, when splitting the OHI-S index into different categories (DI-S and CI-S) it become clear that the diabetics had less plaque on their teeth, but significant more calculus. As suggested in the literature, presence of dental calculus - mineralized bacterial plaque can infuence development of gingivitis. Non-mineralized plaque on the calculus surface is the principal irritant and initiates gingival inflammation, but the underlying calcified portion may be a significant contributing factor. It does not irritate the gingiva directly but provides a fixed nidus for the continued accumulation of plaque and retains it in close proximity to the gingiva [2]. The epidemiological studies show that populations with high prevalence of gingival inflammation and attachment loss also have higher prevalence and extent of dental calculus (for review, see Albandar JM, 2002) [3]. We observed that the children with type I DM had worse gingival status than the non-diabetics. The statistically significant correlation was found between gingivitis and calculus in both study groups.
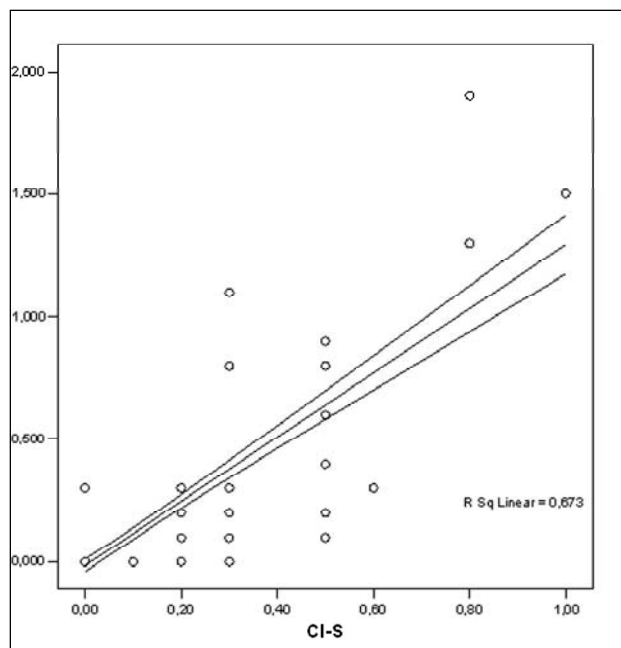

Figure 3. The distribution of the GI index in diabetic and non-diabetic children.

Figure 4. The linear correlation with 95% confidence interval between gingivitis (GI) and calculus (CI-S) in all study children. *Correlation is significant: r=0.82, p<0.001.*

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Higher incidence and severity of gingivitis was shown to be related with poor metabolic control of diabetes [28-30]. It has been speculated that the increased glucose levels in the gingival fluid and blood of individuals with diabetes could change the environment of the microflora, inducing qualitative changes in bacteria that could account for the severity of periodontal problems, observed in poorly controlled individuals with diabetes [15]. Karjalainen et al. suggested that imbalance of glucose metabolism associated with diabetes predisposed to gingival inflammation. An expressed gingival bleeding due to hyperglycemia-associated biological alterations could be explained by lowered host resistance toward plaque [31]. Gislen et al. reported that diabetic children with poor metabolic control showed a clear tendency towards higher gingival index scores than the non-diabetics, while no such tendency was seen between the diabetics with good metabolic control [9].

In contrary, other investigators did not find an association between gingival inflammation and the metabolic control of diabetes [10, 13]. It was suggested by

Hayden et al. that, when diabetic patients suffered periodontitis it could be due to factors other (such as genetic predisposition) than impaired glucose metabolism [32].

Our findings confirmed that the poorly controlled diabetics tended to have higher oral hygiene indices (both DI-S and CI-S) than the well-moderately controlled subjects. A tendency to more severe gingival inflammation was observed in the poorly controlled diabetics, although, due to a small number of subjects in the groups with different

metabolic control it wasn't possible to record a significant difference.

Although, most of the study participants reported that they brushed their teeth at least once a day, the analysis of the clinical data showed relatively high levels of dental plaque in both study groups. Similar findings were reported in the recent study of the oral hygiene habits in Lithuanian school-children: despite the fact that most of the children indicated their regular toothbrushing habits, the plaque scores remained rather high [33]. Possibly, the important factor contributing to the growth and accumulation of plaque on the teeth surfaces could be the failure or inability of the children to maintain adequate daily mechanical plaque removal [34]. Therefore, considering the health risks that potentially could be increased by diabetes mellitus the improved daily oral self-care among children should help to prevent the progression of oral diseases.

CONCLUSIONS

Despite lower dental plaque levels in the diabetic than in the non-diabetic children, the diabetics were more prone to development of gingival inflammation. The presence of dental calculus as a local risk factor associated with gingivitis becomes more severe problem in the individuals with type I diabetes mellitus.

Additional care for prevention of plaque and calculus accumulation could be recommended particularly in patients with poorly controlled diabetes.

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REFERENCES

1. Marsh PD, Nyvad B. The oral microflora and biofilms on teeth. In Fejerskov O, Kidd E, editors. Dental caries. The disease and its clical management. 1nd ed. Copenhagen: Blacwell Munksgard; 2003. p.29-48.
2. Hinrichs JE. The role of dental calculus and other predisposing factors. In Newman MG, Takei HH, Carranza FA, editors. Carranza's clinical periodontology. 9nd ed. Philadelphia: Sauders; 2002. p.182-203.
3. Albandar JM. Global risk factors and risk indicators for periodontal diseases. Periodontology 2000. 2002;29:177-206.
4. Nyvad B. The role of oral hygiene. In Fejerskov O, Kidd E, editors. Dental caries. The disease and its clical management. 1nd ed. Copenhagen: Blackwell Munksgard; 2003. p.171-7.
5. Lopez ME, Colloca ME, Paez RG, Schallmach JN, Koss MA, Chervonarura A. Salivary characteristics of diabetic children. Braz Dent J 2003;14:26-31.
6. Albrecht M, Banoczy J, Tamas GJ. Dental and oral symptoms of diabetes melltus. Community Dent Oral Epidemiol 1988;16:378-80.
7. Jones RB, McCallum RM, Kay EJ, Kirkin V, McDonald P. Oral health and oral health behaviour in a population of diabetic out-patient clinic attenders. Community Dent Oral Epidemiol 1992;20:204-7.
8. Faulconbridge AR, Bradshaw WSL, Jenkins PA, Baum JD. The dental status of a group of diabetic children. Brit Dent J 1981;20:253-5.
9. Gislen G, Nilsson KO, Matsson L. Gingival inflammation in diabetic children related to degree of metabolic control. Acta Odontol Scand 1980;38:241-6.
10. Pinson M, Hoffman WH, Garnick JJ, Litaker MS. Periodontal disease and type I diabetes mellitus in children and adolescents. Clin Periodontol 1995;22:118-23.
11. Goteiner D, Vogel R, Deasy M, Goteiner C: Periodontal and caries experience in children with insulin-dependent diabetes mellitus. J Am Dent Assoc 1986;113:277-9.
12. Sbordone L, Ramaglia L, Barone A, Ciaglia RN, Iacono VJ. Periodontal status and subgingival microbiota of insulin-dependent juvenile diabetics: a 3-year longitudinal study. J Periodontol 1998;69:120-8.
13. de Pommereau V, Dargent-Pare C, Robert JJ, Brion M. Periodontal status in insulin-dependent diabetic adolescents. Clin Periodontol 1992;19:628-32.
14. Sandholm L, Swanljung O, Rytomaa I, Kaprio EA, Maenpaa J. Morphotypes of the subgingival microflora in diabetic adolescents in Finland. J Periodontol 1989;60:526-8.
15. Klokkevold PR, Maeley BL, Carranza FA. Influence of systemic disease and disorders on the periodontium. In Newman MG, Takei HH, Carranza FA, editors. Carranza's clinical periodontology. 9nd ed. Philadelphia: Sauders; 2002. p.204-28.
16. Galea H, Aganovic I, Aganovic M. The dental caries and periodontal disease experience of patients with early onset insulin dependent diabetes. Int Dent J 1986; 36:219-24.
17. International Society for Pediatric and Adolescent Diabetes. Consensus guidelines 2000. ISPAD consensus guidelines for the management of Type 1 diabetes mellitus in children and adolescents. Zeist: Medforum; 2000.
18. Greene JC, Vermillion JR. The simplified oral hygiene index. J Am Diet Assoc 1964;68:7-13.
19. Greene JC. The simlified oral hygiene index – development and uses. J Periodontol 1967;38:625-37.
20. Löe H, Silness J. Periodontal disease in pregnancy(I). Prevalence and severity. Acta Odontol Scand 1963;21:551-3.
21. Löe H. The gingival index, the plaque index and the retention index systems. J Periodontol 1967;38:610-6.
22. Iughetti L, Marino R, Bertolani MF, Bernasconi S: Oral health in children and adolescents with IDDM – a review. J Pediatr Endocrinol Metab 1999;12:603-10.
23. Aren G, Sepet E, Ozdemir D, Dinccag N, Guvener B, Firatli E: Periodontal health, salivary status, and metabolic control in children with type 1 diabetes mellitus. J Periodontol 2003;74:1789-95.
24. Novaes Junior AB, Pereira AL, de Moraes N, Novaes AB. Manifestations of insulin-dependent diabetes mellitus in the periodontium of young Brazilian patients. J Periodontol 1991;62:116-22.
25. Sandholm L, Swanljung O, Rytomaa I, Kaprio EA, Maenpaa J. Periodontal status of Finnish adolescents with insulin-dependent diabetes mellitus. Clin Periodontol 1989;16:617-20.
26. Leeper SH, Kalkwarf KL, Strom EA. Oral status of "controlled" adolescent type I diabetics. J Oral Med 1985;40:127-33.
27. Pinducciu G, Micheletti L, Piras V, Songini C, Serra C, Pompei R et al. Periodontal disease, oral microbial flora and salivary antibacterial factor in diabetes mellitus type 1 patients. Eur J Epidemiol 1996;12:631-6.

Reference list truncated.