



# African Journal of Biological Sciences



Research Paper

Open Access

## An Assessment of Knowledge, Awareness, and Attitude Regarding Periodontal Status for Diabetic Adults with DM1: A Cross-Sectional Study Among the 18-70-Year-Old Libyan Population

Salma Mahfoud<sup>1\*</sup>, Logien El Ghazal<sup>2</sup>, Amelsaad Elbarasi<sup>3</sup>, Nazeha Elzaidy<sup>4</sup><sup>1,2,3</sup>Department of Periodontal, Dental Faculty, University of Benghazi, Libya,<sup>4</sup> Department of Dentistry, Seidi-Hussein Diabetic Center, Benghazi, Libya,

Corresponding author (\*): Salma Mahfoud

Email: [salma.o.mahfoud@gmail.com](mailto:salma.o.mahfoud@gmail.com), [elghazallogien@gmail.com](mailto:elghazallogien@gmail.com), [Amelsaad.elbarasi@eagles.edu](mailto:Amelsaad.elbarasi@eagles.edu), [Nazmelzaid@gmail.com](mailto:Nazmelzaid@gmail.com)

### Article Info

Volume 6, Issue 8, April 2024

Received: 02 Feb 2024

Accepted: 12 March 2024

Published: 07 April 2024

### Abstract

**Background:** Periodontal diseases are chronic inflammatory diseases that affect the supporting tissues of the teeth. Type 1 diabetes mellitus (DM1) can be diagnosed at any age, but this type of diabetes often manifests in children, adolescents, and young adults. DM1 patients exhibit an increased risk of PD.

**Design and methods:** This study was designed to assess the periodontal health status of adult patients who were diagnosed with type 1 diabetes during childhood. Additionally, they are assessed for their knowledge, awareness, and attitude toward periodontal disease. A cross-sectional descriptive study was conducted among one hundred and three diabetic patients diagnosed with type I diabetes during childhood. These patients were selected according to the study criteria from the Seidi-Hussein Diabetic Center in Benghazi, Libya. An interview questionnaire designed to assess knowledge, awareness, and attitudes. Complete periodontal chart recording; probing depth and clinical attachment loss. Plaque and gingival index were obtained for each patient. Patients show a poor attitude towards oral health.

**Results:** The study results indicating an increase in periodontal disease parameters among this sample group. 51.1% of the patients had gingivitis and 47.6% had periodontitis, with CALs of mild 1-2 mm for 34.0%, moderate 2- 4 mm for 11.7% and >5 mm for 1.9%. Results indicates a significant correlation between diabetes duration, periodontal disease severity and tooth loss. A significant association between HbA1C levels, disease severity, recession, and mobility. **Conclusion:** It is important to detect and treat periodontal disease in children with DM at an early age to prevent more destruction in adulthood.

**Key words:** Diabetes, periodontal, DM1, adult patients, health education, Libya.

© 2024 Salma Mahfoud, This is an open access article under the CC BY license (<https://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made

## Introduction

Periodontal diseases: gingivitis and periodontitis are chronic inflammatory diseases of the supporting tissues of the teeth. The main cause of this inflammation is the presence of bacterial biofilms. Diabetes is a well-known risk factor for periodontitis. It is well known, that periodontitis is considered the sixth complication of diabetes<sup>1</sup>.

Type 1 diabetes mellitus (DM1) has an autoimmune cause in which there is destruction of the pancreatic  $\beta$ -cells. It can be diagnosed at any age, but this type of diabetes often manifests in children, adolescents, and young adults<sup>2, 3, 4, 5</sup>.

Glycated hemoglobin (HbA1c) is the key test for the detection and control of diabetes mellitus. It is well documented that the level of glycemic control is important and determined as a risk factor for periodontal disease. Good metabolic control was assumed to be represented by HbA1c <7%, while poor control was defined as HbA1c > 7, and normal is HbA1c < 5.5%.<sup>6, 7</sup>. The new classification of periodontal diseases includes common systemic diseases and conditions that can affect the periodontal system, such as uncontrolled DM<sup>8</sup>.

Systematic reviews and meta-analyses studies presented the association between DM and periodontal health status. They have concluded that DM1 patients exhibited an increased risk of PD.<sup>9, 10, 7</sup>. In addition, DM1 patients showed a severe and more deteriorated periodontal status than healthy controls<sup>11, 12, 13, 14</sup>.

A cohort study explored the influence of T1DM and T2DM on periodontal disease progression over 5 years. It has reported that uncontrolled diabetic status directly influences attachment loss, regardless of the disease type.<sup>15, 16</sup> A higher prevalence of diabetes-related complications is observed in patients with type 1 or type 2 diabetes. This association between DM and PD have been attributed to several mechanisms, including changes in the host's vascular, cellular, and repair processes.<sup>17</sup> It has been shown that hyperglycemia and its severity are primary risk factors for diabetic complications.<sup>18</sup>

**The purpose of the study was to evaluate the periodontal health status of adult patients who were diagnosed early with type 1 diabetes during childhood.** As well as assessing their knowledge, awareness, and attitude regarding periodontal disease after their diagnosis.

## Materials and Methods

We conducted a cross-sectional descriptive study among one hundred and three diabetic patients who were diagnosed with diabetes type I during childhood. Those patients were selected according to the study criteria from Seidi-Hussein Diabetic Center, Benghazi, Libya. This study was conducted from 2021-2023. Informed written consent was obtained for each patient.

### *Inclusion criteria*

- The subjects are aged between 16 and 70 years.
- Both females and males were included.
- Patients diagnosed as type I diabetes mellitus during childhood.
- Patients who do not have any active infection at the time of the study.

### *Exclusion criteria*

- Patients are excluded if they had other types of DM.
- Any inflammatory disease, chronic systemic disease.
- Patients receiving any treatment that could modify the study parameters, such as, antibiotics, immunosuppressants.

There was a structured interview questionnaire (presented after material and methods) that consisted of multiple-choice answers. There were two sections; the first section consisted of questions concerning sociodemographic information and a detailed history of diabetes. Second

section, included questions that evaluated knowledge, awareness, and attitudes regarding oral health care and periodontal disease.

#### *Dental examination*

Thereafter, a full mouth examination was conducted using UCLA periodontal chart recording; probing depth and clinical attachment loss were measured at six sites per tooth using the Michigan o probe with William's calibration; mobility and recession were recorded. According to the number of sites involved with CAL and the severity of CAL for each patient, periodontal disease is diagnosed. Plaque and gingival index were obtained for each patient. <sup>19</sup> After examination, patients were informed about their periodontal condition to receive proper treatment.

#### **I- Demographic personal data:**

- Patient name: .....
- Age----- Sex: Male, Female, Nationality: Libyan, non-Libyan
- Diagnosis:                                 Duration (                                 years )
- Drugs used:
- (HbA1c), latest reading for HbA1c
- Existing diabetic complication: retinopathy, neuropathy, and nephropathy, Non
- Any other medical problem

#### **II- Knowledge, behavior, and attitude related questions:**

- Visit to dentist:                                 regularly                                 when you have pain
- Tooth brush technique (Bass technique, other)
- Frequency: 1,                                 2,                                 3, sometime, None
- Inter-dental aids: yes, none
- Do you have any gum problem:                                 bleeding                                 change in colour                                 swelled gum
- Do you know what is the cause of the gum problem?                                 yes, no
- Did you receive any gum treatment?                                 yes, no
- Do you think that gum disease effect your diabetic control
- Do you think that your disease effect on your periodontal condition

#### **Statistical analysis of the data**

Data were fed to the computer using IBM SPSS software package version 24.0. Data were described using number and percent, mean and standard deviation. Comparison between different groups regarding categorical variables was tested using Chi-square test, significant relation considered at ( $P < 0.05$ ).

#### **Results and Discussion**

There were 103 patients with T1DM in this study (47 males and 56 females), with an average age of  $26.11 \pm 9.026$ . Diabetes duration was ten years in 58 patients, ten to twenty years in 41 patients, and more than twenty years in four patients. Most of the patients, 95.1%, were receiving insulin treatment. Participants' most recent HbA1c measurements were taken and recorded; controlled for 8.9 %, uncontrolled for 12.8%, and poor control for 79%.

In the study sample, 74.8% of the patients had no diabetic complications; however, 12.6% had retinopathy, 7.8% had neuropathy, and 4.9% had nephropathy. A total of 17 patients from the study sample had other health problems, primarily hypertension. As shown in (Table 1).

Table 1. distribution of patients according to their demographic data

	Number	Percent
Age		
< 20	23	22.5
20-40	73	71.1
>40	7	6.7
Range	15-61	
Mean±SD	26.11±9.026	
Sex		
Male	47	45.6
Female	56	54.4
Nationality		
Libyan	101	98.1
non-Libyan	2	1.9
Duration of diabetes		
<10	58	56.3
10-20	41	39.8
>20	4	3.9
Range	1-42	
Mean±SD	10.1±7.0	
Drugs		
Insulin	98	95.1
Insulin and oral hypoglycemic	5	4.9
HbA1C		
Controlled <7	9	8.9
Mild Uncontrolled >7	13	12.8
Uncontrolled >9	81	79
Range	4.4-20	
Mean±SD	9.81±2.59	
Complication of diabetes		
Non	77	74.8
Retinopathy	13	12.6
Neuropathy	8	7.8
Nephropathy	5	4.9
Any other medical health problem		
No	86	83.5
Yes	17	16.5

Total	103	100.0
-------	-----	-------

Based on the distribution of the studied sample regarding oral hygiene measures and dental visits, as shown in (Table 2), 90% of the studied group visited the dentist when they had pain. 95% of the patients applied the incorrect brushing technique to control periodontal disease, and 85.4% had never used an interdental aid.

Table 2. distribution of studied diabetic patients regarding oral hygiene measures.

	No	%
Visit to dentist		
Regularly	13	12.6
When you have pain	90	87.4
Tooth brush technique		
Bass technique	8	7.8
Other	95	92.2
Frequency of brushing		
None	6	5.8
1	26	25.2
2	38	36.9
3	7	6.8
Sometime	26	25.2
Inter dental aids		
Yes	15	14.6
None	88	85.4

On examining patients' knowledge regarding periodontal disease revealed that 69.9% were aware that bleeding is a sign of gum disease. Despite this, the majority were unaware that diabetes and periodontal disease are closely related, as shown in (Table 3).

Table 3. distribution of studied patients group regarding their knowledge about periodontal disease.

	No	%
Gum problem		
No	18	17.5
Bleeding	72	69.9
Change in color	8	7.8
Swelled gum	5	4.9
Cause of the gum problem		
Yes	28	27.2
No	75	72.8
Gum treatment		
Yes	22	21.4
No	81	78.6
Gum diabetic control		

Yes	40	38.8
No	63	61.2
Effect periodontal condition		
Yes	37	35.9
No	66	64.1

The plaque index score showed about 51.5% were fair and 40% were poor in terms of plaque control as shown in (figure 1). Regarding, the gingival and periodontal status of the study sample 51.1 % had gingivitis and 47.6 % had periodontitis with CAL; mild 1-2 mm for 34.0 %, moderate 2-4mm for 11.7% and >5mm for 1.9 % (figure 2).

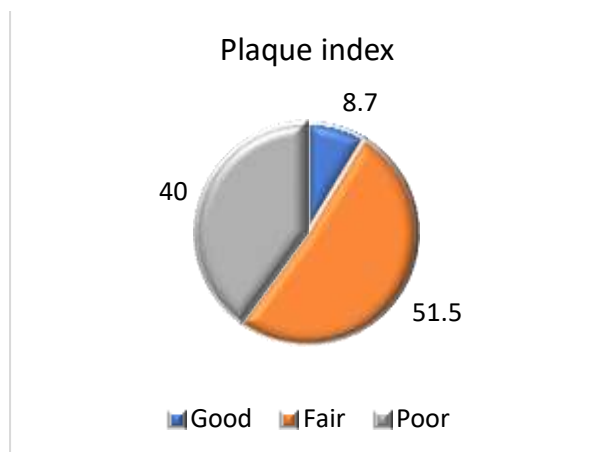


Figure 1. Plaque control index

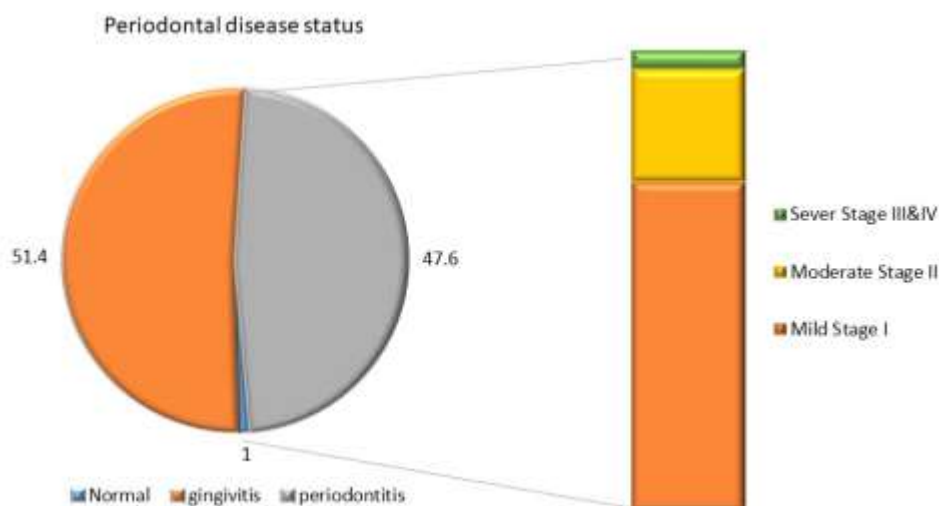


Figure 2. The periodontal disease status among study sample.

There was statistical significant relation between periodontal disease status and basic demographic and clinical data ( $P < 0.05$ ) as shown in (Table 4).

Table 4. Association between demographic data and clinical parameters.

I. Demographic data	Periodontal disease status			Total	X <sup>2</sup> , p value
	Normal "n=1"	Gingivitis "n=53"	Periodontitis "n=49"		

	No.	%	No.	%	No.	%		
Age								
< 20	1	100.0	18	34.0	4	8.2	23	20.11 0.001*
20-40	0	0.0	35	66.0	38	77.6	73	
>40	0	0.0	0	0.0	7	14.3	7	
Sex								
Male	0	0.0	12	22.6	35	71.4	47	16.51
Female	1	100.0	41	77.4	14	28.6	56	0.004*
Duration of treatment								
<10	1	100.0	37	69.8	20	40.8	58	28.9
10 - 20	0	0.0	16	30.2	25	51.0	41	0.001*
>20	0	0.0	0	0.0	4	8.2	4	
HbA1C								
Good controlled <7	1	100.0	8	15.1	0	0.0	9	31.0 0.001*
Uncontrolled > 7	0	0.0	13	24.5	0	0.0	13	
Poor control > 9	0	0.0	32	60.4	49	100.0	81	
Complication								
Non	1	100.0	50	94.3	26	53.1	77	27.1 0.001*
Retinopathy	0	0.0	3	5.7	10	20.4	13	
Neuropathy	0	0.0	0	0.0	8	16.3	8	
Nephropathy	0	0.0	0	0.0	5	10.2	5	

Periodontal status and HbA1c showed a significant statistical relationship. Based on (Table 5), forty-nine poorly controlled patients had a percent of 60.5% suffering from mild to severe periodontitis.

Table 5. Association between periodontal disease status and HbA1C.

Periodontal disease status	HbA1C						Total	X <sup>2</sup> , value	p
	Controlled <7 "N=9"		Uncontrolled >7 "N=13"		Poor-control > 9 "n=81"				
	No.	%	No.	%	No.	%			
Normal	1	11.1	0	0	0	0.0	1	31.0 0.001*	
gingivitis	8	88.9	13	100.0	32	39.5	53		
periodontitis	0	0.0	0	0	49	60.5	49		
<i>Mild periodontitis</i>	0	0.0	0	0	35	43.2	35		
<i>Moderate periodontitis</i>	0	0.0	0	0	12	14.8	12		
<i>Severe periodontitis</i>	0	0.0	0	0	2	2.5	2		

This study demonstrated that there was a significant association between uncontrolled diabetes and the presence of recession and teeth mobility as compared with controlled diabetic patients (Table 6).

Table 6. Association between HbA1C level, recession, and mobility.

	HbA1C						Total	X <sup>2</sup> p value
	Controlled <7		Uncontrolled >7		Poor control >9			
	No.	%	No.	%	No.	%		
Recession								
Yes	0	0.0	4	30.8	51	63.0	55	10.65
No	9	100.0	9	69.2	39	48.1	48	0.012*
Mobility								
Yes	0	0.0	2	15.4	29	35.8	31	22.65
No	9	100.0	11	84.6	63	77.8	72	0.001*

It is evident from Figure 4 that the number of extracted teeth due to PD increases with the duration of diabetes, as the extracted teeth ranged from 8 to 24 teeth when the diabetic duration was more than 25 years.

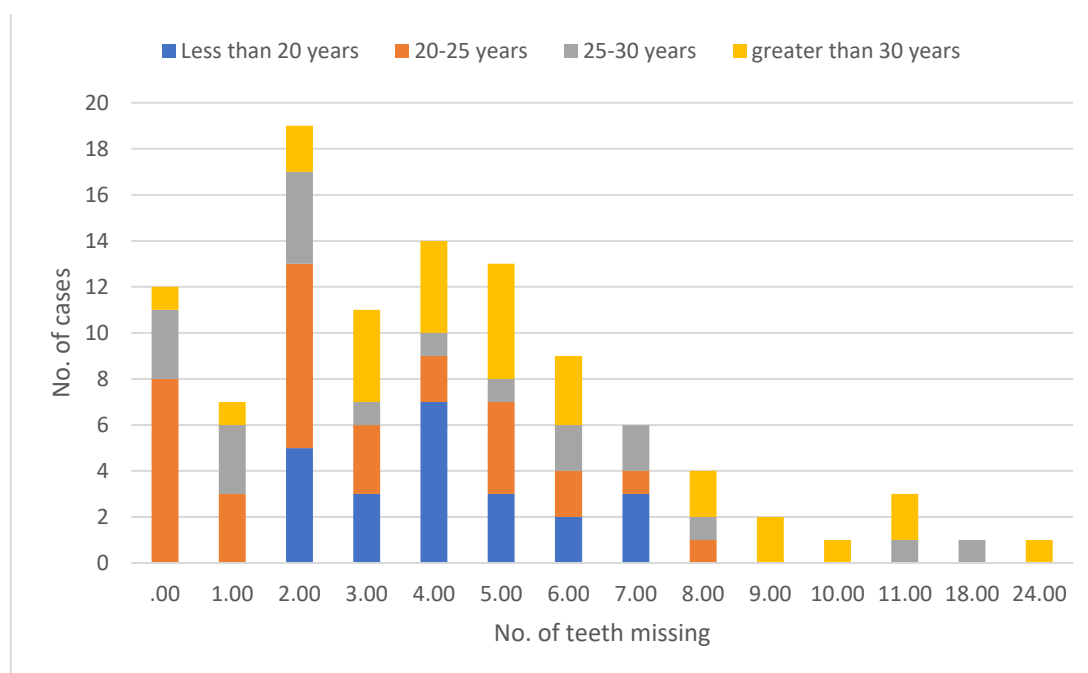


Figure 3. Association between extracted teeth and duration of diabetes

**Discussion**

We conducted a cross-sectional descriptive study on patients with type I diabetes (T1D) aged 18 to 70 years. Diabetes type I is the most common form of diabetes among children and adolescents under the age of 20<sup>20,21</sup>. It is estimated that 1.1 million individuals in this age group suffer from type 1 diabetes (T1D)<sup>21,22,23</sup>. The prevalence of the disease is increasing by more than 1.4% per year (Mayer-Davis et al., 2018).<sup>24</sup>

Patients diagnosed with diabetes are more likely to develop periodontal disease. Further, patients with both diabetes and periodontal disease tend to develop poor glycemic control as well as rapid progression of the periodontal disease, which eventually results in tooth loss<sup>1,22</sup>. The distribution of the studied sample regarding oral hygiene measures and visiting the dentist indicated that 90% of the patients never have regular checkups for their gums, as well as a poor attitude towards oral health as they use improper brushing techniques and never utilize dental aids.



In respect of the gingival and periodontal status of the study sample, 51.1% of it had gingivitis and 47.6% had periodontitis, with CALs of mild 1-2 mm for 34.0%, moderate 2- 4 mm for 11.7% and >5 mm for 1.9%, indicating an increase in periodontal disease parameters among this sample group.

According to the results of this study, the duration of diabetes ranged from 10 to 20 years. This study indicates a significant correlation between diabetes duration and periodontal disease severity, which has also been demonstrated in other studies.<sup>25</sup> About 47.6 % of the population in this sample had attachment loss, ranging from mild to a severe, and the patients with severe periodontitis had long-term diabetes. The duration of the diabetes had an impact on clinical parameters, were patients with more than ten years of diabetic duration presented with deeper probing pocket depth, more bleeding on probing, and higher clinical attachment level.<sup>26, 10</sup>.

According to this study, there is a significant statistical relationship between periodontal status and HbA1c. There is a greater prevalence of periodontitis among uncontrolled diabetic patients (60.5 per cent), whereas moderate to severe periodontitis is apparent among uncontrolled diabetics. This is in accordance to Jindal et al.<sup>28</sup> were they examined the relationship between the severity of PD and glycemic control in DM1. They found that patients with poor metabolic control showed increased inflammation ( $p = 0.015$ ), high levels of dental plaque, and a more loss of clinical attachment.

Another study found that periodontitis was present in 57.9% of DM1 patients and 59.5% of those with poor metabolic control, emphasizing the relationship between impaired glycemic control and an increased risk of periodontal disease.<sup>29</sup> In our study, we found that there were significant associations between HbA1C levels, recession, and mobility, with 63.3%, 35.8% of recession and mobility respectively associated with uncontrolled diabetes.

To prevent more destruction in adulthood, it is important to detect periodontal disease in children with DM at an early age. Patients with DT1 usually experience periodontal disease at an early stage. It was reported that early treatment of gingivitis is to minimize inflammation in the gingival tissues, however, gingivitis treatment can also be specified as a strategy to avoid the development of periodontitis<sup>30, 31</sup>. It is essential that parents and children are educated about periodontal disease and early diagnosis and treatment should be considered a firm goal of such Category programs.<sup>30, 32</sup>.

## Conclusion

Periodontal attachment loss and recession are associated with longer durations of DM and poor metabolic control. As well as, increasing the risk of tooth loss and mobility. Further, the researchers recommend that DM1 patients require specialized periodontal care. Oral health promotions educate patients on the importance of maintaining good oral hygiene and performing periodontal examinations. Thus, reducing the risk of periodontal disease and early tooth loss. To improve the health of diabetic patients, an interdisciplinary approach should be used between diabetes care specialists and periodontists.

## Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Ethics approval

Those patients were selected according to the study criteria from Seidi-Hussein Diabetic Center, Benghazi, Libya.

## Consent to participate

Informed written consent was obtained for each patient.

## Funding

The authors received no financial support for the research, and/or publication of this article.

## References

1. Loe, H. (1993). Periodontal disease. The sixth complication of diabetes mellitus. *Diabetes Care*, 16, 329– 334. <https://doi.org/10.2337/diacare.16.1.329>

2. Reddy, M.; Gopalkrishna, P. Type 1 diabetes and periodontal disease: A literature review. *Can. J. Dent. Hyg.* 2022, 56, 22–30. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8937570/>
3. Graves, D.T.; Ding, Z.; Yang, Y. The impact of diabetes on periodontal diseases. *Periodontology* 2020, 82, 214–224. <https://onlinelibrary.wiley.com/doi/abs/10.1111/prd.12318>
4. Mahalakshmi, K.; Arangannal, P.; Santoshkumari. Frequency of putative periodontal pathogens among type 1 diabetes mellitus: A case-control study. *BMC Res. Notes* 2019, 12, 328. <https://link.springer.com/article/10.1186/s13104-019-4364-3>
5. Daković, D.; Mileusnić, I.; Hajduković, Z.; Čakić, S.; Hadži-Mihajlović, M. Gingivitis and Periodontitis in children and adolescents suffering from type 1 diabetes mellitus. *Vojnosanit. Pregl.* 2015, 72, 265–273. <https://scindeks.ceon.rs/article.aspx?artid=0042-84501503265D>
6. Preshaw, P.M.; Alba, A.L.; Herrera, D.; Jepsen, S.; Konstantinidis, A.; Makrilakis, K.; Taylor, R. Periodontitis and diabetes: A two-way relationship. *Diabetologia* 2012, 55, 21–31. <https://link.springer.com/article/10.1007/s00125-011-2342-y>
7. Sun, K.T.; Chen, S.C.; Lin, C.L.; Hsu, J.T.; Chen, I.A.; Wu, I.T.; Palanisamy, K.; Shen, T.C.; Li, C.Y. The association between Type 1 diabetes mellitus and periodontal diseases. *J. Formos. Med. Assoc.* 2019, 118, 1047–1054. <https://www.sciencedirect.com/science/article/pii/S0929664618305941>
8. Tonetti, M.S.; Greenwell, H.; Kornman, K.S. Staging and grading of periodontitis: Framework and proposal of a new classification and case definition. *J. Periodontol.* 2018, 89, S159–S172, Erratum in: *J. Periodontol.* 2018, 89, 1475. <https://aap.onlinelibrary.wiley.com/doi/full/10.1002/JPER.18-0006>
9. Ajita, M.; Karan, P.; Vivek, G.; Anand, M.S.; Anuj, M. Periodontal disease and type 1 diabetes mellitus: Associations with glycemic control and complications: An Indian perspective. *Diabetes Metab. Syndr.* 2013, 7, 61–63. <https://www.sciencedirect.com/science/article/abs/pii/S1871402113000362>
10. Dakovic, D.; Colic, M.; Cakic, S.; Mileusnic, I.; Hajdukovic, Z.; Stamatovic, N. Salivary interleukin-8 levels in children suffering from Type 1 diabetes mellitus. *J. Clin. Pediatr. Dent.* 2013, 37, 377–380. <https://meridian.allenpress.com/jcpd/article/37/4/377/190454/Salivary-interleukin-8-levels-in-children>
11. Ismail AF, McGrath CP, Yiu CK. Oral health of children with type 1 diabetes mellitus: a systematic review. *Diabetes Res Clin Pract* 2015; 108:369–381. <https://www.sciencedirect.com/science/article/abs/pii/S0168822715001680>
12. Jensen E, Allen G, Bednarz J, Couper J, Pe~na A. Periodontal risk markers in children and adolescents with type 1 diabetes: asystematic review and meta-analysis. *Diabetes Metab Res Rev* 2021; 37: e3368. <https://onlinelibrary.wiley.com/doi/abs/10.1002/dmrr.3368>
13. Rapone B, Corsalini M, Converti I, et al. Does Periodontal inflammation affect type 1 diabetes in childhood and adolescence? A Meta-Analysis. *Front Endocrinol* 2020; 11: 278. <https://www.frontiersin.org/articles/10.3389/fendo.2020.00278/full>
14. Demmer, R. T., Holtfreter, B., Desvarieux, M., Jacobs, D. R., Kerner, W., Nauck, M., ... Kocher, T. The influence of type 1 and type 2 diabetes on periodontal disease progression: Prospective results from the Study of Health in Pomerania (SHIP). *Diabetes Care.* 2012, 35, 2036–2042. <https://doi.org/10.2337/dc11-2453>
15. Borgnakke, W. S., Ylöstalo, P. V., Taylor, G. W., & Genco, R. J. Effect of periodontal disease on diabetes: Systematic review of epidemiologic observational evidence. *Journal of Clinical Periodontology*, 2013, 40, S135–S152. <https://aap.onlinelibrary.wiley.com/doi/abs/10.1902/jop.2013.1340013>
16. Novotna M, Podzimek S, Broukal Z, Lencova E, Duskova J. Periodontal diseases and dental caries in children with type 1 diabetes mellitus. *Mediators Inflamm.* 2015; 2015: 379626. <https://doi:10.1155/2015/379626>.

17. Duda-Sobczak A, Zozulinska-Ziolkiewicz D, Wyganowska- Swiatkowska M. Type 1 diabetes and periodontal health. *Clin Ther.* 2018;40(6):823–27. <https://www.sciencedirect.com/science/article/abs/pii/S0149291818300134>
18. Silness, J. and L6e, H. Periodontal disease in pregnancy II. Correlation between oral hygiene and periodontal condition. *Acta Odont Scand* 22:121, 1964.
19. International Diabetes Federation. IDF Diabetes Atlas. Ninth edition. International Diabetes Federation: Brussels. [cited 22 April 2021]. Available from: <https://www.diabetesatlas.org/en/resources>
20. Tuomilehto J, Ogle GD, Lund-Blix NA, Stene LC. Update on Worldwide Trends in Occurrence of Childhood Type 1 Diabetes in 2020. *Pediatr Endocrinol Rev* 2020; 17: 198-209.vol17.2020.tol.epidemiologychildtype1diabetes. <https://europepmc.org/article/med/32208564>
21. A systematic review and meta-analysis of epidemiologic observational evidence on the effect of periodontitis on diabetes An update of the EFP-AAP review; [Filippo Graziani](#) , [Stefano Gennai](#) , [Anna Solini](#) , [Morena Petrini](#) ; 26 December 2017 [journal of Clinical Periodontology Volume 45, Issue 2](#) p. 167-187 <https://doi.org/10.1111/jcpe.12837>
22. Evanthia Lalla, Bin cheng, shantanu Lal, Sid tucker, ellen greenberg, Gobin goland; Periodontal changes in children andAdolescents with diabetesDiabetes care, volume 29, number 2, february 2006. <https://diabetesjournals.org/care/article/29/2/295/26203/Periodontal-Changes-in-Children-and-Adolescents>
23. Mayer-Davis, E. J., Kahkoska, A. R., Jefferies, C., Dabelea, D., Balde, N.,Gong, C. X., ... Craig, M. E. (2018). ISPAD Clinical Practice ConsensusGuidelines 2018: Definition, epidemiology, and classification of diabetes in children and adolescents. *Pediatric Diabetes*, 19 (Suppl 27),7–19. <https://doi.org/10.1111/pedi.12773>
24. Ismail AF, McGrath CP, Yiu CK. Oral health of children with type 1 diabetes mellitus: a systematic review. *Diabetes Res Clin Pract.* 2015;108(3):369–381. <https://www.sciencedirect.com/science/article/abs/pii/S0168822715001680>
25. Firatli E, Yilmaz O, Onan U. The relationship between clinical attachment loss and duration of insulin-dependent diabetes mellitus (IDDM) in children and adolescents. *J Clin Periodontol.* 1996; 23:362–6. <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1600-051X.1996.tb00558.x>
26. Dicembrini I, Serni L, Monami M, Caliri M, Barbato L, Cairo F, et al. Type 1 diabetes and periodontitis: prevalence and periodontal destruction—a systematic review. *Acta Diabetol.* 2020;57(12):1405–1412. <https://link.springer.com/article/10.1007/s00592-020-01531-7>
27. Jindal, A.; Parihar, A.S.; Sood, M.; Singh, P.; Singh, N. Relationship between severity of periodontal disease and control of diabetes (glycated hemoglobin) in patients with type 1 diabetes mellitus. *J. Int. Oral Health* 2015, 7, 17–20. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4672852/>
28. Popławska-Kita, A.; Siewko, K.; Szpak, P.; Król, B.; Telejko, B.; Klimiuk, P.A.; Stokowska, W.; Górski, M.; Szelachowska, M. Association between type 1 diabetes and periodontal health. *Adv. Med. Sci.* 2014, 59, 126–131. <https://www.sciencedirect.com/science/article/abs/pii/S1896112614000121>
29. CHAPPLE, I. L., VAN DER WEIJDEN, F., DOERFER, C., HERRERA, D., SHAPIRA, L., POLAK, D., MADIANOS, P., LOUROPOULOU, A., MACHTEI, E. & DONOS, N. Primary prevention of periodontitis: managing gingivitis. *Journal of clinical periodontology.* 2015, 42, (S16), S71-S76. <https://onlinelibrary.wiley.com/doi/full/10.1111/jcpe.12366>
30. .E.D.; Selway, C.A.; Allen, G.; Bednarz, J.; Weyrich, L.S.; Gue, S.; Peña, A.S.; Couper, J. Early markers of periodontal disease and altered oral microbiota are associated with glycemic control in children with type 1 diabetes. *Pediatr. Diabetes* 2021, 22, 474–481. <https://onlinelibrary.wiley.com/doi/abs/10.1111/pedi.13170>
31. Mounika Reddy\*, BDS; Pratibha Gopalkrishna; Type 1 diabetes and periodontal disease: a literature review *Can J Dent Hyg* 2022;56(1): 22-30. <https://pubmed.ncbi.nlm.nih.gov/35401764/>

32. Z Zainal Abidin,\* ZA Zainuren,\* E Noor,† NS Mohd Nor,‡ S Mohd Saffian,§ R Abdul Halim\*Periodontal health status of children and adolescents with diabetes mellitus: a systematic review and meta-analysis Australian Dental Journal 2021; 66:(1 Suppl) S15-S26. <https://doi.org/10.1111/adj.12845>