





Research



Prevalence and factors associated with periodontal disease in patients with diabetes mellitus attending Kiruddu National Referral Hospital, Uganda

Haruna Muhmood Kiryowa,  Ian Guyton Munabi,  William Buwembo, Charles Mugisha Rwenyonyi,  Mark Kaddumukasa,  Erisa Mwaka Sabakaki

Corresponding author: Haruna Muhmood Kiryowa, School of Biomedical Sciences, College of Health Sciences, Makerere University, Kampala, Uganda. kiryowa2005@yahoo.com

Received: 22 Jun 2022 - **Accepted:** 04 Nov 2022 - **Published:** 23 Dec 2022

Keywords: Diabetes mellitus, glycemic control, HbA1c, periodontal disease

Copyright: Haruna Muhmood Kiryowa et al. Pan African Medical Journal (ISSN: 1937-8688). This is an Open Access article distributed under the terms of the Creative Commons Attribution International 4.0 License (<https://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Cite this article: Haruna Muhmood Kiryowa et al. Prevalence and factors associated with periodontal disease in patients with diabetes mellitus attending Kiruddu National Referral Hospital, Uganda. Pan African Medical Journal. 2022;43(202). 10.11604/pamj.2022.43.202.35971

Available online at: <https://www.panafrican-med-journal.com//content/article/43/202/full>

Prevalence and factors associated with periodontal disease in patients with diabetes mellitus attending Kiruddu National Referral Hospital, Uganda

Haruna Muhmood Kiryowa^{1,&}, Ian Guyton Munabi¹, William Buwembo¹, Charles Mugisha Rwenyonyi², Mark Kaddumukasa³, Erisa Mwaka Sabakaki¹

¹School of Biomedical Sciences, College of Health Sciences, Makerere University, Kampala, Uganda,

²School of Health Sciences, College of Health Sciences, Makerere University, Kampala, Uganda,

³School of Medicine, College of Health Sciences, Makerere University, Kampala, Uganda

&Corresponding author

Haruna Muhmood Kiryowa, School of Biomedical Sciences, College of Health Sciences, Makerere University, Kampala, Uganda

Abstract

Introduction: patients with diabetes mellitus present with high rates of periodontal disease. Severity and extent of periodontal disease may be directly associated with poor glycemic control. The burden of periodontal disease in patients with diabetes mellitus in Uganda is not documented. This study set out to determine the prevalence and factors associated with periodontal disease in patients with diabetes mellitus attending a national referral hospital in Uganda. **Methods:** this was a cross-sectional study involving 264 patients with diabetes mellitus. Data were collected using a pretested questionnaire to assess factors associated with periodontal disease. This was followed by an oral examination to determine the community periodontal index (CPI) and clinical attachment loss (CAL). Laboratory tests included glycated hemoglobin and fasting blood sugar. Factors associated with periodontal diseases were evaluated using logistic regression analysis. **Results:** of the 264 participants, 68.9% were females. The average age was 48.9 (SD = 11.0) years. Majority of the participants (32.6%) had diabetes mellitus for 2 to 5 years with oral hypoglycemic drugs being the most commonly (55.7%) used medication. The overall prevalence of periodontal disease was 85%. Univariate analysis revealed that prevalence of periodontal disease was associated with male sex, lower level of education, smoking, oral hygiene practices, poor glycemic control and combined diabetic medication. However, based on multivariate model, this prevalence was only significantly associated with lower level of education: aOR: 10.77 95% CI 1.04-226.38, $p=0.05$. **Conclusion:** periodontal disease is highly prevalent in patients with diabetes mellitus in Uganda, especially those with a lower level of education. All diabetic patients should be screened and managed for periodontal disease. Oral health interventions should also be packaged and presented in a simple language to allow easy comprehension by even the less educated population.

Introduction

The rate at which the prevalence of diabetes mellitus is increasing has become a concern to mankind [1]. Available data show that about 6.8% of the population worldwide is affected by the disease [2]. A systematic review, Mukamusoni *et al.* [3] reported an average prevalence of 13.7% in the African population. In Uganda, approximately 10.3% of the population have clinically diagnosed diabetes mellitus [4]. Periodontal disease has been identified as one of the early signs of diabetes mellitus [5]. About 95% of patients with diabetes mellitus have some degree of periodontal destruction [6]. Asthana *et al.* [7] revealed that periodontal disease is more prevalent and severe in patients with diabetes mellitus than their counterparts. Periodontal disease may initiate insulin resistance thereby worsening glycemic control [7], which in turn, may lead to an increased extent and severity of periodontal disease [8]. Despite the fact that about 84% of patients with diabetes mellitus in Uganda have poor glycemic control [9], the association between periodontal disease and diabetes mellitus has not been investigated. The present study was aimed at determining the prevalence and factors associated with periodontal disease in patients with diabetes mellitus attending Kiruddu National Referral Hospital in Uganda.

Methods

Study design and setting: this was a cross-sectional study conducted between December 2020 and February 2022 in the Outpatient Department of Kiruddu National Referral Hospital. The hospital is a public facility located in Kampala, capital city of Uganda. The diabetic clinic is one of the 14 specialized out-patients clinics in Kiruddu Hospital. The hospital medical records indicate that the diabetic clinic attends to about twenty new patients on daily basis.

Study population: study participants comprised of adult patients with a confirmed diagnosis of

diabetes mellitus who provided written informed consent before participating in the study. Individuals who were pregnant, or had a history of periodontal treatment in the last 6 months were excluded from the study. The sample size was estimated using Kish Leslie formula where $p = 0.437$, $e = 0.05$ and Z value = 1.645 with statistical power of 90%. The study participants ($n=267$) were selected using simple random sampling.

Data collection: data were collected using a pre tested questionnaire administered by a trained research assistant. The weight in kilograms and height in meters of the participants were determined using a weighing scale (KINLEE, China) and a measuring tape (BYLOO, China), respectively. The measurements were used to calculate the Body Mass Index (BMI). An automated glucometer (Contour Plus, Switzerland) was used to determine the fasting blood sugar while HbA1c levels were determined using an automated analyser (LabonaCheck™ A1cHbA1c, CERAGEM MEDISYS INC, South Korea). An oral examination was carried out by a trained dental surgeon using a mouth mirror and a calibrated periodontal probe (Koushen, China) to determine the Community Periodontal Index (CPI) and the Clinical Attachment Loss (CAL). The data were recorded on the World Health Organization Oral Health Assessment form for adults. The CPI values were recorded as 0, normal; 1 and 2, gingivitis; 3, pockets < 4 mm (mild periodontitis) and 4, pockets > 4 mm (severe periodontitis).

Definitions: the outcome variable was periodontal disease. Periodontal disease was defined as presence of either gingivitis or periodontitis. The independent variables included age, sex, level of education, oral hygiene practices, history of active smoking, glycemic control and type of diabetic medication. Level of education was classified into no formal education, primary, secondary and tertiary. Oral hygiene practices were categorized into inadequate (brushing teeth less than twice a day) and adequate (brushing teeth more than twice a day).

Statistical analysis: data were entered in Microsoft Excel, cleaned and exported to R (version 4.10) for analysis. Participants were divided into two groups, according to the presence or absence of periodontal disease. Continuous variables were presented as means and standard deviations while categorical variables were presented as percentages. Univariate analysis was used to determine the association between periodontal disease and the independent variables. All independent variables were employed in the multivariate regression analysis because of their potential role in pathogenesis of periodontal disease. P values < 0.05 were considered as statistically significant.

Ethical considerations: the study protocol was approved by Makerere University School of Biomedical Sciences Research Ethics Committee (Ref. no. SBS-899) and Uganda National Council of Science and Technology (Ref. no. HS1853ES). The participants gave written informed consent before their enrolment in the study in accordance with Helsinki Declaration [10]. All data were assigned special codes and stored in a password-protected computer. No identifying information of the participants was included in data collection.

Source of funding: this study was sponsored by the Government of Uganda through the Makerere University Research and Innovation Fund (MAK-RIF 1).

Results

General characteristics of the study population: of the 267 participants, 3 were excluded from the study, for reasons of being completely edentulous ($n=1$), failing venipuncture ($n=1$) and withdrawing informed consent ($n=1$), leaving 264 for the analysis (Figure 1). Most participants (68.9%) were females (Table 1). The average age was 48.9 (SD = 11.0) years. Most participants (78.0%) had attained either primary or secondary education and 14.0% had no formal education. Majority of the participants (93.6%) reported brushing their teeth once (40.6%) or twice (52.6%) a day

(Table 1). Only 3.8% reported active smoking. About 97.3% of the participants were earning less than one million Uganda shillings per month. About half (51.6%) of the participants had lived with diabetes mellitus for at least 6 years. The most (55.7%) common form of diabetic medication was oral hypoglycemics while a combination of oral hypoglycemics and injectable insulin was used by 31.4% of the participants. The average body mass index (BMI) was 29.5 (SD=5.78) and mean HbA1c was 8.84 (SD=2.57) (Table 1).

Prevalence of periodontal disease: most participants (85.2%) had periodontal disease, which was categorized as gingivitis (25%), mild periodontitis (31.8%) and severe periodontitis (28.4%) (Table 1).

Factors associated with periodontal disease: based on univariate analysis prevalence of periodontal disease was associated with male sex, level of education, oral hygiene practices, poor glycemic control and combined diabetic medication. From multivariate regression, this association was only significant for lower level of education (aOR: 10.77 95% CI 1.04-226.38, $p=0.05$; Table 2).

Discussion

This study set out to investigate the prevalence and factors associated with periodontal disease in adult patients with diabetes mellitus. There was a high prevalence of periodontal disease, which was significantly associated with lower level of education. The prevalence of periodontal disease in this study was 85.2%, with 60.2% of participants having periodontitis and 25%, gingivitis. This prevalence is higher than the 67.8% that was reported in a recent metanalysis involving 3092 patients with diabetes mellitus and 23,494 controls [11]. It was similarly higher than the 45.9% that was reported by Nand *et al.* [12] in a rural Indian population. This difference in prevalence could be attributed to the poor glycemic control in the majority of our participants. Poor glycemic control is one of the factors that has been

associated with a high prevalence of periodontal disease in patients with diabetes mellitus [13]. This is true for our study where the mean HbA1c in both groups was greater than 7.0 indicating that most of the participants had poor glycemic control. Inadequate oral hygiene, especially in patients with diabetes mellitus may also have contributed to the increase prevalence of periodontal disease in our study population [14]. Our findings indicate that participants who practiced inadequate oral hygiene had a four percent chance of having periodontal disease compared to those who practiced adequate oral hygiene. Kabali *et al.* also reported a low prevalence of periodontal disease in participants who practiced good oral hygiene [15]. Poor oral hygiene practices accelerate accumulation of plaque, an important reservoir for the periodontopathogenic microorganisms.

Males in this study had a sixty-eight percent higher chance of having periodontal disease than females. This is consistent with reports from several other studies that have highlighted the role of male sex as a risk factor for periodontal disease [16,17]. Males usually exhibit relatively poor oral hygiene practices when compared to females [18]. Male participants with poor oral hygiene are more prone to development of periodontal disease than their female counterparts [19]. Older age and smoking have also been identified as risk factors for periodontal disease in male sex [17]. Smoking whether in males or females alters oral microbiome as well causes direct tissue destruction [20]. Though our findings indicate that the chances of having periodontal disease were three percent more in active smokers than in the non-smokers, the number of participants who reported active smoking was small. In addition, the gender differences in smoking status were not evaluated. It is thus difficult to conclude that smoking was an independent risk factor for development of periodontal disease in the male sex.

This study investigated the association between age and periodontal disease. We note that for every unit decrease in age, there was a 4% decrease in odds of having periodontal disease. Eriksson *et al.*

have reported ageing to be associated with an increased incidence of periodontal disease [21]. On the other hand, Prankeviciene *et al.* reported that periodontal disease was more prevalent in the younger patients with diabetes mellitus [22]. However, that particular study was conducted in participants with type one diabetes mellitus whose early exposure to chronic glycaemia predisposed them to higher risks of developing periodontitis [23]. Much as our findings suggest that participants with periodontal disease were slightly older than those without periodontal disease, there was no significant variations in the mean age of the two populations. Periodontal disease has been reported to be more common in the older individuals. Though the risk factors for periodontal disease in the elderly are no different from the younger population, it is important that older people are keeping their teeth longer hence prolonging their exposure to periodontopathogenic bacteria. In addition, older individuals may present with a number of systemic conditions which have a direct or indirect link to the pathophysiology of periodontal disease.

In this study, participants who had no formal education were six times more likely to have periodontal disease than those who had attained primary education. The odds for a person with no formal education having periodontal disease increased for every additional increase in level of education. This was statistically significant (p value = 0.04). Our findings are consistent with Masriadi *et al.* who reported low level of education to be a risk factor for periodontal disease [24]. The level of education and income status are one of the measures of socioeconomic status. Individuals with low level of education are more likely to be poor and unable to afford periodontal treatments which are in most cases expensive, thereby increasing chances of having periodontal disease [25]. Socioeconomic factors like primary education and low social class have been reported to be associated with a greater prevalence of periodontal disease in the adult population [26]. This is true for our study where 97.3% of the participants were earning less than one million Uganda shillings per

month which is less than 350 US Dollars per month (Table 1).

Participants using combined therapy of oral hypoglycemics and insulin in this study were twice more likely to have periodontal disease than those who were using insulin alone, and the chances were thirteen percent when compared to those who were using oral hypoglycemics. We opine that this may be related to the association between type of anti-diabetic medication and glycemic control [27,28].

This study had some limitations. It employed a cross-sectional study design to determine the factors associated with periodontal disease. A case-control design would have been the ideal design for this study. The study was also conducted during the COVID-19 epidemic. This might have affected the results of this study.

Conclusion

Periodontal disease is highly prevalent in patients with diabetes mellitus in Uganda, especially those with a lower level of education. All diabetic patients should be screened and managed for periodontal disease. Oral health interventions should also be packaged and presented in a simple form to allow easy comprehension by the target population.

What is known about this topic

- *There is a high prevalence of periodontal disease in patients with diabetes mellitus;*
- *The factors associated with periodontal disease in patients without diabetes mellitus increase the risk for development of this condition in patients with diabetes mellitus.*

What this study adds

- *Unlike the general consensus that diabetes mellitus mainly affects individuals of the medium to high socioeconomic status, most of the participants from this study were of low socioeconomic status; this is evidenced by the lower level of education and low-income status;*

- *Apart from the common factors associated with periodontal disease in both patients with and without diabetes mellitus, type of diabetic medication may play an important role in predisposing patients with diabetes mellitus to increased risk of development of periodontal disease; further studies need to be conducted to confirm this association.*

Competing interests

The authors declare no competing interests.

Authors' contributions

Conception, study design and data collection: Haruna Muhmood Kiryowa; data analysis and interpretation: Haruna Muhmood Kiryowa, Erisa Mwaka Sabakaki, William Buwembo, Mark Kaddumukasa and Ian Guyton Munabi; manuscript drafting: Haruna Muhmood Kiryowa; manuscript revision: Haruna Muhmood Kiryowa, Ian Guyton Munabi, William Buwembo, Charles Mugisha Rwenyonyi, Mark Kaddumukasa and Erisa Mwaka Sabakaki; guarantor of the study: Haruna Muhmood Kiryowa. All the authors read and approved the final version of this manuscript.

Acknowledgments

We would like to extend our sincere appreciation to the Makerere University Research and Innovation Fund for sponsoring this study. Special thanks to all the study participants and staff of Kiruddu National Referral Hospital.

Tables and figure

Table 1: descriptive characteristics of study participants

Table 2: results of logistic regression analysis of factors associated with periodontal disease in study participants

Figure 1: flow chart showing participant recruitment

References

1. Lin X, Xu Y, Pan X, Xu J, Ding Y, Sun X *et al.* Global, regional, and national burden and trend of diabetes in 195 countries and territories: an analysis from 1990 to 2025. *Sci Rep.* 2020 Sep 8;10(1): 14790. **PubMed** | **Google Scholar**
2. Khan MAB, Hashim MJ, King JK, Govender RD, Mustafa H, Al Kaabi J. Epidemiology of Type 2 Diabetes - Global Burden of Disease and Forecasted Trends. *J Epidemiol Glob Health.* 2020;10(1): 107-11. **PubMed** | **Google Scholar**
3. Mukamusoni D, Ndabarora E. Systematic review of diabetes mellitus prevalence and determinants of early detection in Africa. *KPSCJ.* 2018;1(1). **Google Scholar**
4. Chiwanga FS, Njelekela MA, Diamond MB, Bajunirwe F, Guwatudde D, Nankya-Mutyoba J *et al.* Urban and rural prevalence of diabetes and pre-diabetes and risk factors associated with diabetes in Tanzania and Uganda. *Glob Health Action.* 2016 May 23;9: 31440. **PubMed** | **Google Scholar**
5. Teeuw WJ, Kosho MXF, Poland DCW, Gerdes VEA, Loos BG. Periodontitis as a possible early sign of diabetes mellitus. *BMJ Open Diabetes Res Care.* 2017 Jan 19;5(1): e000326. **PubMed** | **Google Scholar**
6. Singh M, Bains V, Jhingran R, Srivastava R, Madan R, Maurya S *et al.* Prevalence of Periodontal Disease in Type 2 Diabetes Mellitus Patients: A Cross-sectional Study. *Contemp Clin Dent.* 2019 Apr-Jun;10(2): 349-357. **PubMed** | **Google Scholar**
7. Asthana G, Chhina S. Interplay between Periodontal Disease and diabetes mellitus. *Indian J Gastroenterol.* 2021;12(3): 122-6. **Google Scholar**
8. Stoicescu M, Calniceanu H, Tig I, Nemeth S, Tent A, Popa A *et al.* Significant aspects and correlation between glycemic control and generalised chronic periodontitis in type 2 diabetes mellitus. *Exp Ther Med.* 2021 Jul;22(1): 671. **PubMed** | **Google Scholar**

9. Patrick NB, Yadesa TM, Muhindo R, Lutoti S. Poor Glycemic Control and the Contributing Factors Among Type 2 Diabetes Mellitus Patients Attending Outpatient Diabetes Clinic at Mbarara Regional Referral Hospital, Uganda. *Diabetes Metab Syndr Obes.* 2021;14: 3123-30. **PubMed** | **Google Scholar**
10. Goodyear MD, Krleza-Jeric K, Lemmens T. The Declaration of Helsinki. *BMJ.* 2007 Sep 29;335(7621): 624-5. **PubMed** | **Google Scholar**
11. 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): 1405-12. **PubMed** | **Google Scholar**
12. Nand KY, Oommen AM, Chacko RK, Abraham VJ. Chronic periodontitis among diabetics and nondiabetics aged 35-65 years, in a rural block in Vellore, Tamil Nadu: A cross-sectional study. *J Indian Soc Periodontol.* 2017 Jul-Aug;21(4): 309-314. **PubMed** | **Google Scholar**
13. Katagiri S, Nitta H, Nagasawa T, Izumi Y, Kanazawa M, Matsuo A *et al.* Effect of glycemic control on periodontitis in type 2 diabetic patients with periodontal disease. *J Diabetes Investig.* 2013 May;4(3): 320-325. **PubMed** | **Google Scholar**
14. Lertpimonchai A, Rattanasiri S, Arj-Ong Vallibhakara S, Attia J, Thakkinstian A. The association between oral hygiene and periodontitis: a systematic review and meta-analysis. *Int Dent J.* 2017 Dec;67(6): 332-43. **PubMed** | **Google Scholar**
15. Kabali TM, Mumghamba EG. Knowledge of Periodontal Diseases, Oral Hygiene Practices, and Self-Reported Periodontal Problems among Pregnant Women and Postnatal Mothers Attending Reproductive and Child Health Clinics in Rural Zambia. *Int J Dent.* 2018 Aug 7;2018: 9782092. **PubMed** | **Google Scholar**
16. Schulze A, Busse M. Gender Differences in Periodontal Status and Oral Hygiene of Non-Diabetic and Type 2 Diabetic Patients. *Open Dent J.* 2016 Jun 9;10: 287-97. **PubMed** | **Google Scholar**
17. Cepeda S, Weinstein R, Blacketer C, Lynch MC. Association of flossing/interdental cleaning and periodontitis in adults. *J Clin Epidemiol.* 2017;44: 866-71. **Google Scholar**
18. Salim NA, Alamoush RA, Al-Abdallah MM, Al-Asmar AA, Satterthwaite JD. Relationship between dental caries, oral hygiene and malocclusion among Syrian refugee children and adolescents: a cross-sectional study. *BMC Oral Health.* 2021 Dec 7;21(1): 629. **PubMed** | **Google Scholar**
19. Rafique T, Rasel MSH, Nazmul M. A Case Control study on the risk factors of Periodontitis. *IOSR Journal of Dental and Medical Sciences.* 2014;13(4): 41-6. **Google Scholar**
20. Nazir MA. Prevalence of periodontal disease, its association with systemic diseases and prevention. *Int J Health Sci (Qassim).* 2017 Apr-Jun;11(2): 72-80. **PubMed** | **Google Scholar**
21. Eriksson K, Nise L, Kats A, Luttrupp E, Catrina AI, Askling J *et al.* Prevalence of Periodontitis in Patients with Established Rheumatoid Arthritis: A Swedish Population Based Case-Control Study. *PLoS One.* 2016 May 20;11(5): e0155956. **PubMed** | **Google Scholar**
22. Pranckeviciene A, Siudikiene J, Ostrauskas R, Machiulskiene V. Severity of periodontal disease in adult patients with diabetes mellitus in relation to the type of diabetes. *Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub.* 2014;158(1): 117-23. **PubMed** | **Google Scholar**
23. Ajita M, Karan P, Vivek G, S MA, Anuj M. Periodontal disease and type 1 diabetes mellitus: associations with glycemic control and complications: an Indian perspective. *Diabetes Metab Syndr.* 2013 Apr-Jun;7(2): 61-3. **PubMed** | **Google Scholar**
24. Masriadi, Irawati E, Chotimah C, Pamewa K, Aslan S, Hamzah M. Risk Factors for Periodontal Disease in Diabetes Mellitus Type 2 Patients at Padongko Health Center, Barru Regency (Study Epidemiology). *Systemic Review Pharmacy.* 2020;11(11): 1501-5. **Google Scholar**

25. Bomfim RA, Frias AC, Pannuti CM, Zilbovicius C, Pereira AC. Socio-economic factors associated with periodontal conditions among Brazilian elderly people - Multilevel analysis of the SBSP-15 study. *PLoS One*. 2018 Nov 7;13(11): e0206730. **PubMed** | **Google Scholar**
26. Almerich-Silla J-M, Almiñana-Pastor PJ, Boronat-Catalá M, Bellot-Arcís C, Montiel-Company J-M. Socioeconomic factors and severity of periodontal disease in adults (35-44 years). A cross-sectional study. *J Clin Exp Dent*. 2017;9(8): e988-e994. **PubMed** | **Google Scholar**
27. Nigussie S, Birhan N, Amare F, Mengistu G, Adem F, Abegaz TM. Rate of glycemic control and associated factors among type two diabetes mellitus patients in Ethiopia: A cross sectional study. *PLoS One*. 2021 May 11;16(5): e0251506. **PubMed** | **Google Scholar**
28. Huri HZ, Ling DYH, Ahmad WAW. Association between glycemic control and antidiabetic drugs in type 2 diabetes mellitus patients with cardiovascular complications. *Drug Des Devel Ther*. 2015;9: 4735-49. **PubMed** | **Google Scholar**

Table 1: descriptive characteristics of study participants	
Variable	Overall (N=264)
Sex	
Male	82 (31.1%)
Female	182 (68.9%)
Age	
Mean (SD)	48.9 (11.0)
Level of education	
No formal education	37 (14.0%)
Primary	123 (46.6%)
Secondary	83 (31.4%)
Tertiary	21 (8.0%)
Frequency of teeth cleaning	
None	4 (1.5%)
Once	108 (40.9%)
Twice	139 (52.7%)
Thrice	13 (4.9%)
Mode of teeth cleaning	
None	4 (1.5%)
Brushing stick	4 (1.5%)
Tooth brush	9 (3.4%)
Tooth brush plus tooth paste	245 (92.8%)
Tooth brush, tooth paste and floss	2 (0.8%)
Income status	
Low (less than one million Ug. Shs p.m)	257 (97.3%)
High (greater than one million Ug. Shs p.m)	7 (2.7%)
History of smoking	
Yes	10 (3.8%)
No	254 (96.2%)
Mode of smoking	
Cigarettes	6 (2.3%)
Pipes	2 (0.8%)
Tobacco	2 (0.8%)
None	254 (96.2%)
Total years with diabetes	
Less than 1 year	42 (15.9%)
2-5 years	86 (32.6%)
6-10 years	62 (23.5%)
Greater than 10 years	74 (28.0%)
BMI (kg/m²)	
Mean (SD)	29.5 (5.78)
Fasting blood sugar	
Mean (SD)	11.4 (5.53)
HbA1c (%)	
Mean (SD)	8.84 (2.57)
Periodontal status	
Normal	39 (14.8%)
Gingivitis	66 (25.0%)
Mild periodontitis	84 (31.8%)
Severe periodontitis	75 (28.4%)
Ug: Uganda; Shs: shillings; p.m: per month; BMI: body mass index	

Table 2: results of logistic regression analysis of factors associated with periodontal disease in study participants

Dependent: periodontal disease	Attributes	Periodontal disease	Normal	OR (univariable)	aOR (multivariable)
Sex	Male	72 (87.8)	10 (12.2)	-	-
	Female	153 (84.1)	29 (15.9)	1.36 (0.65-3.08, p=0.43)	1.68 (0.72-4.26, p=0.25)
Age	Mean (SD)	49.6 (10.5)	44.4 (12.4)	0.96 (0.92-0.99, p<0.01)	0.96 (0.93-1.00, p=0.03)
Level of education	No formal education	36 (97.3)	1 (2.7)	-	-
	Primary	106 (86.2)	17 (13.8)	5.77 (1.12-105.86, p=0.09)	5.99 (1.13-110.90, p=0.09)
	Secondary	67 (80.7)	16 (19.3)	8.60 (1.65-158.29, p=0.04)	7.54 (1.36-142.02, p=0.06)
	Tertiary	16 (76.2)	5 (23.8)	11.25 (1.64-225.01, p=0.03)	10.77 (1.40-226.38, p=0.04)
Smoking	Yes	9 (90.0)	1 (10.0)	-	-
	No	216 (85.0)	38 (15.0)	1.58 (0.29-29.62, p=0.67)	1.03 (0.15-20.68, p=0.98)
HbA1c	Mean (SD)	8.9 (2.6)	8.4 (2.6)	0.93 (0.80-1.06, p=0.30)	0.89 (0.76-1.03, p=0.12)
BMI	Mean (SD)	29.4 (5.9)	30.2 (5.2)	1.02 (0.96-1.08, p=0.47)	1.01 (0.94-1.07, p=0.81)
Oral hygiene	Inadequate	97 (86.6)	15 (13.4)	-	-
	Adequate	128 (84.2)	24 (15.8)	1.21 (0.61-2.48, p=0.59)	1.04 (0.50-2.22, p=0.92)
Diabetic medication	Both	73 (88.0)	10 (12.0)	-	-
	Insulin	26 (74.3)	9 (25.7)	2.53 (0.91-6.97, p=0.07)	2.57 (0.86-7.64, p=0.09)
	Oral	126 (86.3)	20 (13.7)	1.16 (0.52-2.71, p=0.72)	1.13 (0.49-2.73, p=0.78)

BMI: body mass index

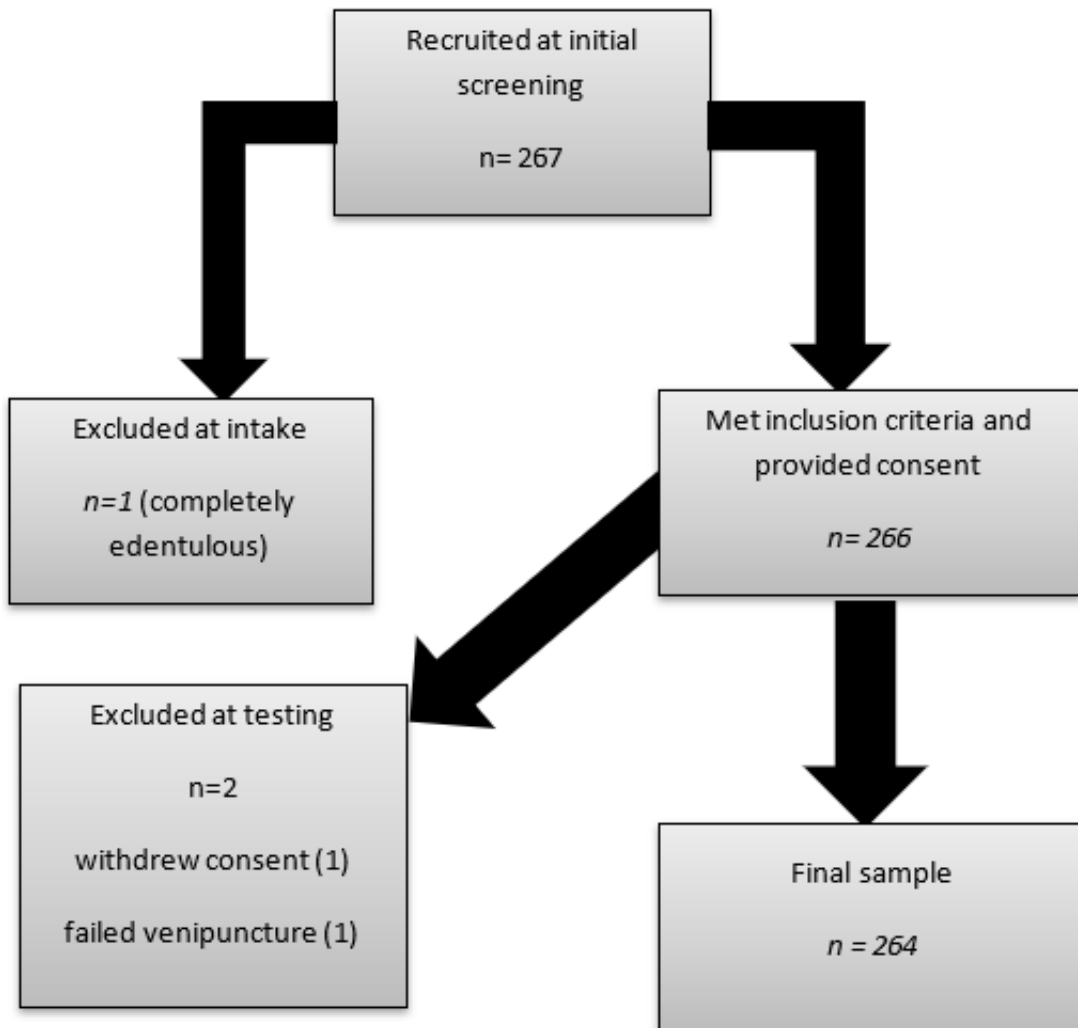


Figure 1: flow chart showing participant recruitment