

# Prevalence of dental caries among patients with type 2 diabetes and without diabetes attending an outpatient clinic in a tertiary care hospital

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## Abstract

**Introduction:** Dental caries can be an oral sign of poor glycaemic control in individuals with Diabetes Mellitus. We aim to describe the prevalence of dental caries and the stages of caries and dental extractions between patients with diabetes and without diabetes attending outpatient clinics. We also aim to describe the association of dental caries with the duration of diabetes.

**Methods:** A cross sectional study was conducted from June 2021 to March 2023 using an interviewer administered questionnaire and oral examination at the outpatient medical clinic. Data were analysed under means, standard deviations and chi square. P value was set at .05.

**Results:** Out of 439 in this study group, 50.3% had diabetes 49.7% did not have diabetes. Their respective FBS means(SD) were  $7.59 \pm 2.47$  and  $5.35 (SD \pm .78)$  which were significant ( $p < .001$ ). Patients with diabetes (172) had significant prevalence of caries than those without diabetes (151)  $p = .042$ . The prevalence of different stages of caries also showed significant differences between patients with diabetes and patients without diabetes ( $p = .033$ ). Severity of dental caries was not associated with the duration of diabetes ( $p = .866$ ). Previous tooth extractions in patients with diabetes and patients without diabetes were not significant as participants who had extractions were 213 and 202 respectively ( $p = .569$ ). Further, patients with diabetes (137) had higher prevalence of unsatisfactory oral hygiene than in those without diabetes (100) participants ( $p < .001$ ).

**Conclusions:** Prevalence of dental caries was significantly higher in patients with type 2 diabetes than in those without. There was a significant difference in the severity of dental caries between the two groups.

**Key words:** diabetes mellitus, fasting blood sugar, dental caries, tooth extraction

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## Introduction

Rising burden of type 2 diabetes is a major concern in healthcare worldwide.(1) The International Diabetes Federation reports that more than 387 million people worldwide currently suffer from diabetes.(2) Diabetes mellitus is a systemic disease which causes micro vascular and macro vascular complications.(1) Oral complications like periodontal diseases and dental caries are concomitantly prevalent in patients with diabetes.(3)

Oral diseases are the most prevalent diseases globally and have a health burden, greatly reducing quality of life for those affected worldwide.(4) Dental caries is the localised destruction of dental hard tissues by acidic by-products from the bacterial fermentation of free sugars.(5) Increased consumption of carbohydrates has shown a widespread increase in dental caries.(6) The relationship between diabetes and dental caries, particularly among adults, has received less attention.(7) Insulin deficiency in diabetes may lead to elevated salivary glucose level, which may put patients with diabetes at a high risk of developing caries.(8) In patients with diabetes there is often reduced salivary flow associated with diabetes medications and neuropathy affecting the salivary glands which may lead to increased caries.(9)

Strategies to prevent root caries should be adopted in individuals with type 2 diabetes mellitus (DM).(10) Meta-analysis proved that those with type 1 diabetes have a high risk of dental caries.(11) No significant differences were found between patients with type 2 diabetes and controls and between well-controlled and poorly controlled diabetics.(11) Taylor et al. concluded in their literature review that there was insufficient evidence to determine whether a relationship exists between diabetes and coronal or root caries risk and recommended that further investigations should be carried out.(9) The limited availability of data, about prevalence of dental caries among type 2 diabetes patients in our region, made us realise the importance of researching this valuable information.

We designed this study at outpatient medical clinics and the main purpose of this study was to determine the prevalence of dental caries among type 2 diabetes patients and to compare them to those without diabetes. The other objectives were to compare severity of dental caries in these two groups and to identify any difference in the severity of caries according to the duration of diabetes. We also compared the number of dental extractions and

fillings among these two groups.

## Methods

### Study design, study population and sampling method:

This descriptive cross sectional study was carried out in the out-patient medical clinic at Teaching Hospital Peradeniya from June 2021 to March 2023. Ethical clearance was obtained from the Research and Ethical Review Committee of National Hospital Kandy. Further approval was taken from the Education Training and Research Unit of the Ministry of Health. Administrative clearance was obtained from the director of Teaching Hospital Peradeniya before starting data collection.

We included type 2 diabetes patients between age 30 to 65 years in the first group and the age and sex matched non-diabetic patients in the second group. Patients with type 1 DM were excluded. Patients who did not have investigations to confirm or exclude diabetes status in clinic records within one year prior to assessment date and patients with both type 2 diabetes and those without diabetes who were not within ages 30 and 65 years were excluded.

Generally, patients attending the medical clinic have already been screened for their diabetes status during their initial evaluation or in subsequent assessment using fasting blood sugar (FBS) or post prandial blood sugar (PPBS). Thus, our intention was not to screen patients for diabetes within the study. In the group without diabetes, we checked individual clinic records to confirm whether diabetes had been excluded effectively during initial or subsequent assessment within the last year. Since every patient with diabetes had either FBS or PPBS for their monthly clinic visit, we used those data to assess diabetes status. If the HbA1C (glycosylated haemoglobin) report was available within the preceding 3 months, we included those data as well. Since the HbA1C test was not readily available for clinic patients during this study period, we could not obtain HbA1C results of the majority of diabetes patients who participated in the study.

The study participants were explained about the nature and the purpose of the study prior to the recruitment. Informed written consent was obtained from participants in one of 3 languages depending on their preference. Study participants were selected using simple random sampling and they had the freedom to make their decision without affecting the routine care at the clinic.

### Sample size calculation and sample size:

Sample size of the group of patients with type 2 diabetes was calculated according to population proportioning (A foundation for analysis in the health sciences by Daniel W. Biostatistic) and using Lwanga and Lemeshow equation along with the application of a Finite Population Correction (Adequacy of sample size in health studies by Ogston SA, Lemeshow S, Hosmer DW et al).(12,13)

The final sample size was calculated using  $n = N * X / (X + N - 1)$  formula, where X= Lwanga and Lemeshow equation and n=sample size. N or population size was 500 according to clinic records of diabetes patients at the clinic. X was calculated using  $X = Z^2 * p * (1 - p) / d^2$  where Z (standard error) was 1.960 at 95% confidence interval, p (anticipated population proportion) was .5 and d (precision) was .05. According to these formulae X=384 and final sample size (n) was 218. As age and sex matched controls were used in this study, the sample size for the control group or participants without diabetes mellitus was also 218.

### Study tool and method of data collection:

Data were collected using an interviewer administered questionnaire. The questionnaire consisted of demographic data and diabetes related data like duration, medication, glucose control etc. Principal investigator was a dental surgeon who did oral examinations of all participants to look for caries, number of extractions, fillings and oral hygiene with the help of a spot light and a reclined chair as allocating a dental chair for a large number of participants was not practical. Drying of the tooth surface during the examination was done using sterile cotton wool. Oral hygiene was assessed using the number of caries, plaques and the level of inflammation of gum during oral examination. Since we had a limited number of mirrors and probes, only 12 participants had oral examinations per day. The interviewer administered questionnaire was completed by co-investigators who were supervised by the principal investigator throughout the study.

### Data analysis:

Participants' identities were not disclosed and each patient was given a unique identification number. Data was organised using the MS Excel spreadsheet package. It was decided to keep electronic data with the principal investigator for three years before discarding it. All data were statistically analysed using SPSS 26.0 software. Quantitative data were analysed

using descriptive statistics (mean, mode, percentage etc.). Comparisons were done using independent sample t-test and chi square test with 95% confidence interval. The level of significance (p) was set at .05.

### Results

Among 439 participants, 303 (68.1 %) were females and 136 (38.9%) were males. Participants with diabetes and without diabetes were 221 (50.3%) and 218 (49.7%) respectively. Duration was categorised as diabetes for less than 5 years and diabetes for more than 5 years. Number of each category was 110.

FBS values in the diabetes group are shown in figure 1. Mean (SD) FBS values of patients with diabetes and without diabetes were 7.57 ( $\pm 2.47$ ) and 5.35 ( $\pm .78$ ) respectively and this was statistically significant ( $p < .001$ ).

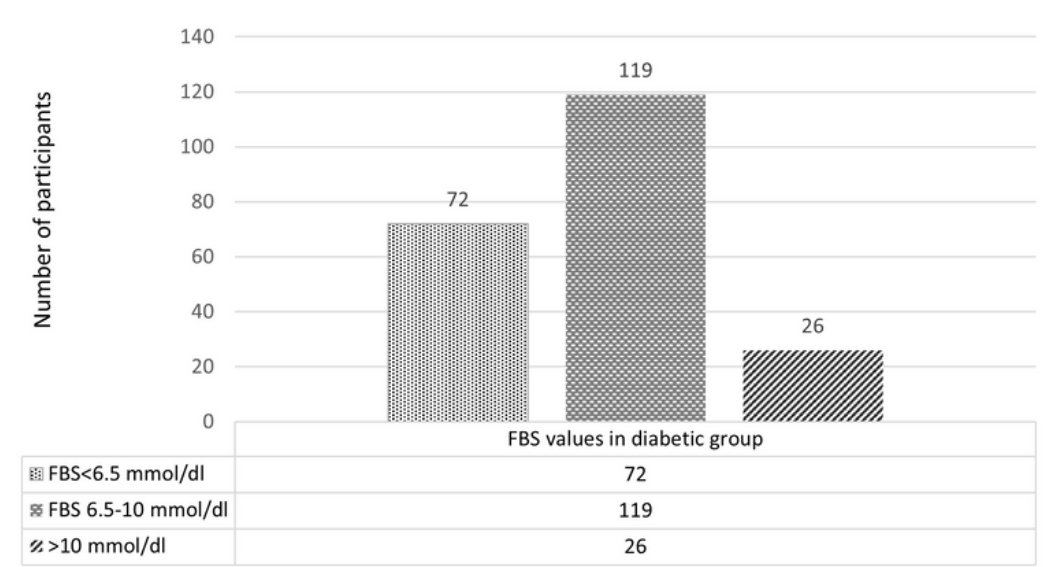
HbA1C values within the preceding 3 months were available only in 103 (46.6%) out of 221. Out of them 43 had HbA1c of less than 6.5%, 21 had HbA1c values between 6.5 and 8.5% and 39 had values more than 8.5%.

In the group with diabetes 187 (84.6%) were on oral hypoglycaemic drugs, 14 (6.3%) were on insulin only and 5 (2.2%) were on both oral hypoglycaemic drugs and insulin. Only dietary measures were followed by 9%. Prevalence of hypertension and dyslipidaemia were 238 (54.2%) and 213 (48.5%) of the total 439 participants.

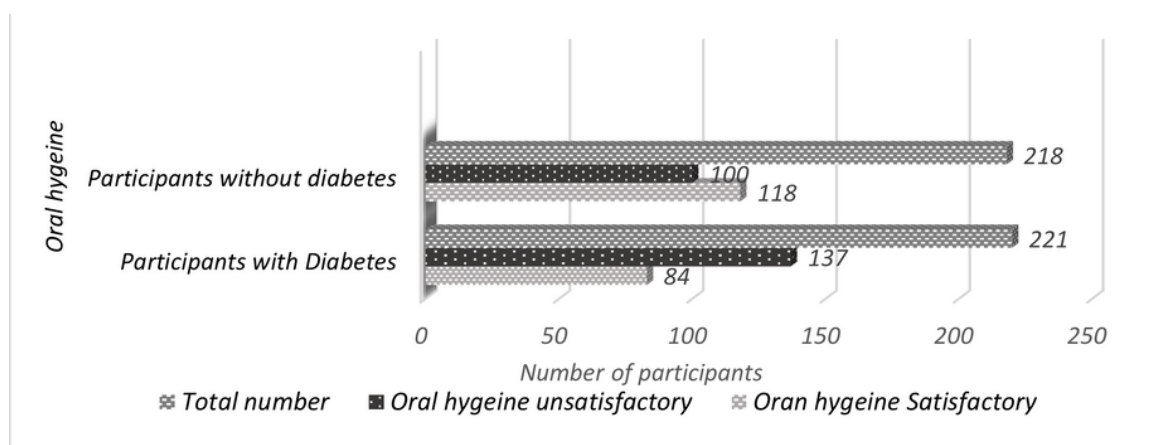
Satisfactory and unsatisfactory oral hygiene in patients with diabetes and without diabetes is shown in figure 2. Comparison between these two groups showed significantly high unsatisfactory oral hygiene in the group with diabetes ( $p < .001$ ).

In the whole group, the average number (SD) of teeth present was 22.32 ( $\pm 8.53$ ) in men and 21.16 ( $\pm 8.14$ ) in women. Average teeth present in the whole study group was 21.49 out of 32. In those with diabetes the average (SD) teeth present was 20.84 ( $\pm 8.047$ ) whereas in those without diabetes the average teeth present was 22.15 ( $\pm 8.54$ ) which was not significant ( $p = .1$ ).

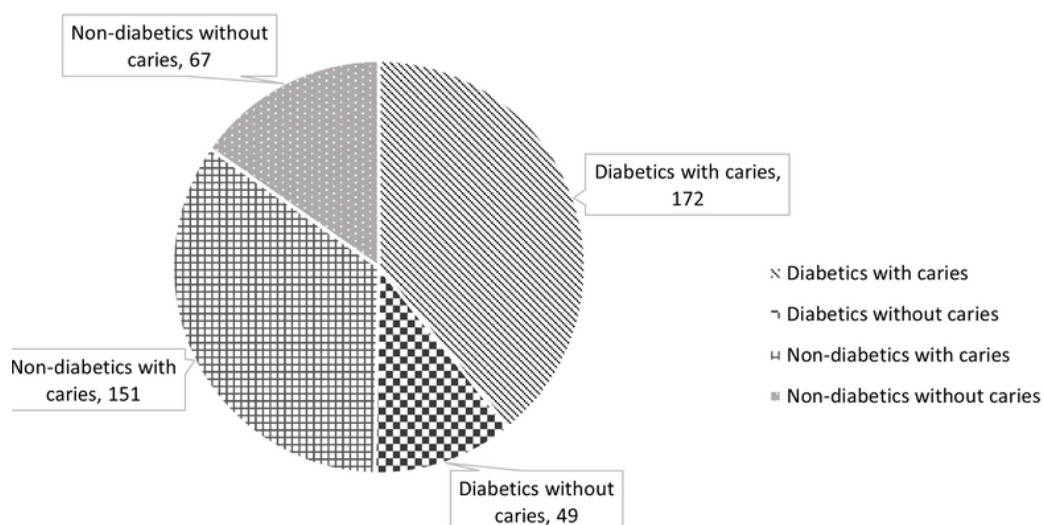
Duration of diabetes was categorised as less than 5 years and more than 5 years. Average teeth present in patients with diabetes for less than 5 years was 21.58 ( $\pm 7.59$ ) while it was 20.00 ( $\pm 8.40$ ) in those more than 5 years. This was not significant ( $p = .144$ ).



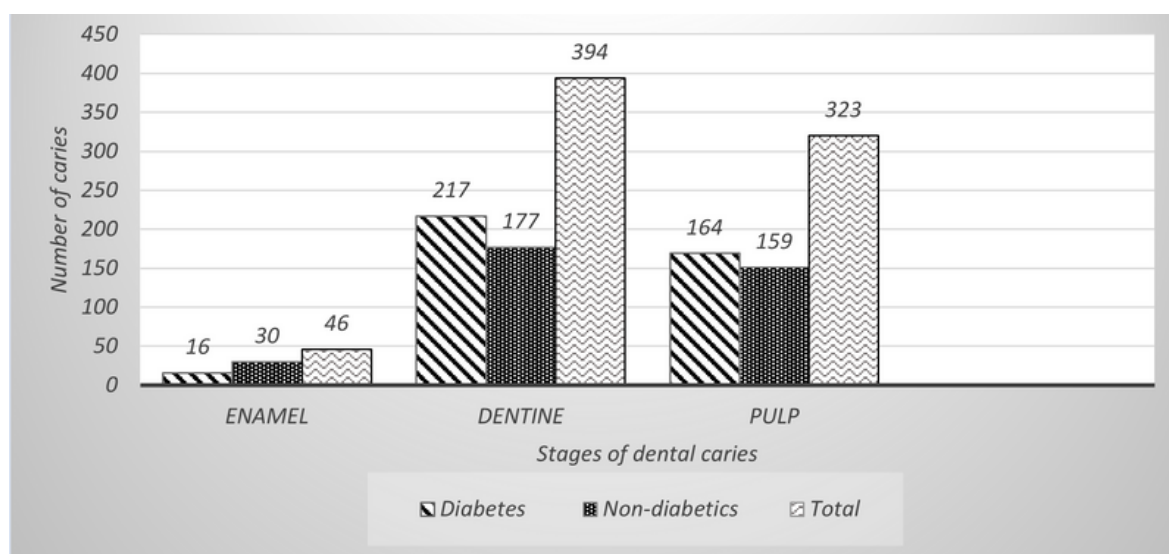
**Figure 1** - FBS values of participants with diabetes mellitus



**Figure 2** - Comparison of oral hygiene in diabetes and non-diabetes patients



**Figure 3** - Number of participants with and without caries in the study group



**Figure 4** - Presence of different stages of dental caries in diabetes and non-diabetes patients

Participants with dental caries and without dental caries in both participants with diabetes and those without diabetes are described in figure 3. This was statistically significant as 77.8% in the group with diabetes and 69.3% in those without had dental caries. ( $p = .042$ )

Many participants with dental caries had more than one dental caries which was either in the same stage or in different stages. Presence of different stages of caries between diabetes and non-diabetes groups are described in figure 4. This comparison was statistically significant as chi-square value was 6.80 and  $p = .033$ .

Severity of caries was assessed according to stages of dental caries. Number of participants with diabetes for less than 5 years who had caries involving enamel, dentine and pulp were 9, 104 and 84 respectively. Number of participants with diabetes for more than 5 years who had enamel, dentine and pulp involvement were 7, 105 and 80 respectively. This comparison was statistically not significant ( $p = .866$ ). The precise staging of caries may need radiological assessment as well.

In the group with diabetes and the group without diabetes, the number of fillings found were 20 (9%) and 25 (11.5%) respectively. Level of significance was not assessed as numbers were too small.

Out of 439 individuals, 415 (94.3%) had undergone tooth extractions where 213 had diabetes and 202 did not have diabetes which was not significant ( $p = .569$ ). Out of 415 participants with tooth extractions

406 (97.2%), mentioned teeth decaying as the main reason for dental extractions. In both groups 178 participants mentioned tooth mobility as the second commonest reason for dental extraction. Other reasons for tooth extraction were impaction and fracture reported by 3 and 7 respectively.

## Discussion

Participants in the group with diabetes had significantly higher mean FBS than the group without diabetes. This was an expected finding as optimum blood sugar control in diabetes patients are practically difficult to achieve. High prevalence of dental caries was seen in both patients with diabetes and those without. However there was a statistically significant higher prevalence of dental caries in type 2 diabetes patients than in those without and this finding was different to previous meta-analysis done by Coelho *et al.*(11) There was a significant difference in different stages of dental caries between the two groups. Poor glycaemic control made patients with diabetes more likely to have caries.(10) Presence of caries involving dentine was higher in the group with diabetes than in the group without. However, there was no significant difference between prevalence of dental caries and the duration of diabetes and this finding was similar to a previous study.(16) There was a large number of missing teeth in both diabetes and non-diabetes participants due to extractions. Many dental extractions in both groups were due to dental caries and mobility of teeth as mentioned by study participants. There was no statistically significant difference between the diabetes and non-diabetes groups with regard to presence of missing teeth. In



addition to the high prevalence of dental caries, other factors like lack of knowledge about dental restorative methods and high cost for such treatments may have contributed to the large number of dental extractions. However we did not assess this area in our study. Presence of poor oral hygiene is significantly high in the group with diabetes in this study. The improvement of oral hygiene is emphasised in previous studies.(14) Effective management of diabetes should be a public health priority to reduce the financial burden.(15)

In this study group, prevalence of hypertension and dyslipidaemia were quite high as this was a clinic based sample rather than from the general population.

### Limitations:

HbA1c was one of the main investigations in this study. However, it was not readily available during this study period. All participants in the group with diabetes had a recent FBS test done at the time of collecting data though it was not the best parameter to assess diabetes control. FBS of patients without diabetes was not available for the majority at the time of the study. Instead, we checked clinic records and confirmed that FBS of patients without diabetes was normal within the preceding 1 year period. These were the main limitations identified. Further, there was a difficulty in identifying the exact number of previous dental extractions related to dental caries in both groups as participants could not recall exact reasons for dental extractions. Examination for dental caries in a non-dental clinic as well as not using radiological evidence to stage dental caries were other limitations of this study. Further, evaluation of salivary parameters were not considered in the study as facilities were not available.

### Conclusions

Prevalence of dental caries among patients with type 2 diabetes was higher than those without diabetes and there was a significant difference in severity of dental caries between the two groups. There's no difference in the prevalence of dental caries in groups with diabetes for less than 5 years and more than 5 years. Further investigation of dental plaques, salivary parameters and fluoride levels would help to improve study outcome as causes for dental caries are multifactorial. Extractions of teeth in both patients with diabetes and those without were quite high without any noticeable significance between the two groups and the main contributory factors were

dental caries and tooth mobility. Extraction of teeth may represent disease activity in the past.

### Recommendations:

Implementation of routine dental assessment could be considered for patients with diabetes mellitus. Introducing a referral system to dental clinics for Type 2 diabetes patients would help to identify and treat oral complications like dental caries at early stages. Performing further studies eliminating limitations identified in this study in multiple medical clinics, would help us to get adequate information to initiate such an assessment system.

### Declarations

#### Author contributions

All authors contributed to the conceptualization and design of the study. Manatunge S R, Ariyawansa T A and Gunawardana W P M contributed to the acquisition of data. Ariyawansa T A and Manatunge S R conducted the data analysis. Ariyawansa T A and Manatunge S R contributed to data interpretation and writing the manuscript. All authors read and approved the final manuscript.

#### Conflicts of interest

The authors declare that they have no conflicts of interest with respect to the research, authorship, and/or publication of this article.

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#### Ethics approval

Ethics approval was obtained from the Ethics Review Committee of the Research and Ethical Review committee of National Hospital Kandy (Ref Number NHK/ERC/34/2021)

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