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## RESEARCH ARTICLE

### INFLUENCE OF COVARIATES ON ORAL HEALTH STATUS OF PATIENTS WITH TYPE 2 DIABETES IN BANGALORE: A HOSPITAL BASED STUDY

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#### ABSTRACT

**Background and Aim:** Oral complications of diabetes are numerous and often affected by other variables. This study was conducted to determine the influence of demographic and other covariates on the oral health status of patients with Type 2 Diabetes Mellitus. **Method:** An in-vivo cross-sectional analytical study was conducted where in 1200 subjects in the age group of 35 – 74 years with type 2 diabetes mellitus were examined in a hospital setting in Bangalore. Data regarding demographic details, time since onset of diabetes, and history of any adverse habits was collected. Oral health status was assessed using WHO oral health assessment form, 1997. Random Blood Sugar on the day of examination was recorded. **Results:** The study opined that all covariates assessed had an effect on caries status, periodontal status, loss of attachment, presence of oral mucosal lesions and prosthetic need of the subjects ( $p < 0.05$ ) in the final model of logistic regression analysis done using backward elimination. Unaffected factors were TMJ signs and symptoms. **Conclusion:** Other factors such as age, onset of diabetes, habits and SES can further worsen oral health status of diabetic patients.

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## INTRODUCTION

Mouth is considered the mirror of the body. Oral health often reflects systemic health and vice versa. With extensive research, it has been established today that a number of systemic diseases have oral manifestations which contribute to the overall deteriorating health of the individual. Diabetes Mellitus is one such disease which has a well-established bidirectional relationship with oral health. Diabetes Mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both. It is a chronic illness that requires continuing medical care and ongoing patient self-management, education and support to prevent acute complications and to reduce the risk of long-term complications.<sup>1</sup>

Diabetes care is complex and requires multifactorial risk reduction strategies beyond glycemic control. The World Health Organization recognizes any disease with a prevalence of more than 1% as a disease of public health significance.<sup>2</sup> According to the International Diabetes Federation number of people suffering from diabetes worldwide is 371 million i.e. a prevalence of 8.3%. 63 million people in India suffer from diabetes i.e. a prevalence of 9.01%. These figures are second only to China.<sup>3</sup> This number is expected to increase to 87 million by the year 2030.<sup>4</sup> The correlation between diabetes and oral diseases has been discussed in literature for several decades now. The oral health complications reportedly associated with diabetes include periodontitis, xerostomia, tooth loss, gingivitis, odontogenic abscess, dental caries and opportunistic infections of tongue and oral mucosa.<sup>5</sup> Today diseases are being viewed through the lens of multifactorial causation and influence of sociodemographic factors on prognosis. Diabetes and its oral complications is no exception to this theory hence the present study aims to determine the

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Influence of covariates on oral health status of patients with Type2 diabetes in Bangalore.

## MATERIALS AND METHODS

This cross-sectional analytical study was conducted in the outpatient department of Government General Hospital, Yelahanka, Bangalore, Karnataka. The sampling frame was 35-74 year old patients diagnosed with type2 diabetes mellitus since the past 3 years who reported to the outpatient department of Government General Hospital Yelahanka, Bangalore. Subjects who have been diagnosed with type-2 diabetes mellitus since the past 3 years at the time of examination. And within the age group of 35-74 years were included in the study. Subjects with known Insulin Dependent Diabetes Mellitus/Gestational diabetes. And any immunosuppressive diseases were excluded. The estimated sample size for the proposed study is 1200, which was obtained as per the following formula.

$$N = (Z^2 (1 - \alpha/2)(1-p)) / (\epsilon^2 p)$$

Where,

N = sample size

Z = 1.96 when  $\alpha$  is assumed to be 0.05.

$\epsilon$  = 0.15, variance estimated to be 15%

p = 12.4%, prevalence of diabetes in Bangalore 5,6

$$N = ( [1.96]^2 (1-0.05/2)(1-0.124) ) / ( [0.15]^2 \times 0.124 )$$

$$N = 1,176.025 \approx 1200$$

Convenience sampling technique was used to select the study population. Outpatients reporting to the aforementioned hospital having Type 2 Diabetes Mellitus were examined till the required sample size is achieved. The diabetic status of the patients was confirmed using the medical records of the patients and random blood sugar analysis was done on the day of examination. Ethical clearance was obtained from Institutional Review Board (IRB) of Krishnadevaraya College of Dental Sciences, Bangalore. The required official permission to select, examine and collect the relevant data from selected subjects had been obtained from the Medical Superintendent of Government General Hospital Yelahanka. Informed consent was obtained from each individual before conducting interview and clinical examination. The principal examiner was trained and calibrated and intra examiner reliability "Kappa" was found to be good at 0.88. The assessment form consisted of two sections. The first section consisted of socio-demographic information comprising age, gender, education, income, occupation (for calculation of SES) years since onset of diabetes, tobacco habits and other medical conditions and the Random Blood Sugar level on that day. The socioeconomic status of the study participants was measured using Kuppuswamy's socioeconomic scale.<sup>6</sup> The second part of the form assessed oral health status of the study participants. Oral Health Status was assessed by using the WHO Oral Health Assessment form 1997.

**Statistical Analysis:** The data was entered into MS-office Excel sheet and subjected to statistical analysis using the statistical package for social sciences (SPSS) version 10.5. The frequencies and percentages were calculated from the descriptive data collected. Logistic Regression Analysis estimated the degree to which Age, Gender, SES, Medications for Diabetes, Tobacco Habit, and duration of diabetes affected

the various components of oral health status. The association of these variables was first assessed using univariate analysis. The categorical variables were assessed using  $\chi^2$  test. Odds Ratio (OR) and 95% Confidence Interval (CI) were calculated. To estimate the independent effect of the factors that were significantly associated with domain functional score and to control the confounding effect they may have on each other, logistic regression analysis was done. The variables were included if their respective univariate analysis yielded  $P < 0.10$ . A backward stepwise elimination procedure based on the likelihood statistics, (using removal probability of 0.10 and considering the change in classification accuracy) was also performed to identify the best subset of variables. In all the above tests the 'p' value of less than 0.05 was accepted as indicating statistical significance.

## RESULTS

This is a cross sectional analytical study to determine the influence of sociodemographic covariates on oral health status of dabetics. Figure 1 and Table 1 describe the study population. A total of 1200 subjects were examined amongst whom 201 (16.7%) were in the age group of 35-39 years, 333 (27.8%) were 40-49 year olds, 312 (26.0%) belonged to the age group of 50-59 years and 230 (19.2) were 60-69 years of age and 124 (10.3) were 70 and above. The number of males in the study were 791 (65.9%) and females were 409 (34.1%).

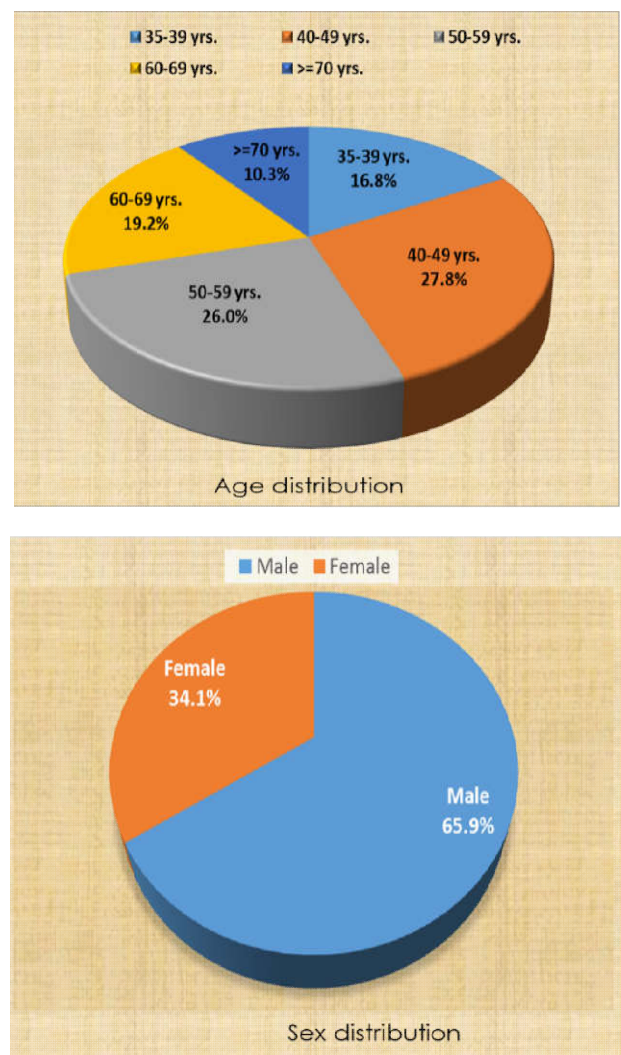


Figure 1: Age and Sex distribution of study participants

**Table 2. Represents oral health status of Study participants**

Characteristic	Frequency	Percent
<b>Socioeconomic Status</b>		
Class I	81	6.7
Class II	139	11.6
Class III	293	24.4
Class IV	654	54.5
Class V	33	2.8
Total	1200	100.0
<b>Tobacco History</b>		
Current/ Past User	471	39.3
Never	729	60.8
Total	1200	100.0
<b>On Medication</b>		
Yes	1011	84.3
No	189	15.8
Total	1200	100.0
<b>Years Since Onset of Diabetes</b>		
3 - 5 yrs.	625	52.1
6-10 yrs.	336	28.0
>10 yrs.	239	19.9
Total	1200	100.0

**Table 2. Prevalence of Various Oral Health Conditions among Study participants expressed in percentages**

Dental Caries	Decayed – 52.10	–	Missing – 51.30	Filled – 11.40
Mean DMFT	D – 1.67		M – 4.72	F – 0.27
Pockets	Present – 56.80		Absent – 43.20	
Loss of Attachment	Present – 76.40		Absent – 23.60	
Prosthetic Status	Absent – 89.8		Single Arch – 8.3	Both Arches – 1.9
Prosthetic Need	Absent – 55.2		Single Arch – 20.3	Both Arches – 24.5
Temporomandibular Joint (TMJ) Signs	Present – 18.8		Absent – 81.2	
TMJ Symptoms	Present – 6.5		Absent – 93.5	
Oral Mucosal Lesions	Present – 16.9		Absent – 83.1	

The subjects were classified into five socioeconomic Classes as per Kuppuswamy's classification of socioeconomic scale; 81(6.7) subjects belonged to Socioeconomic Scale class I, 139 (11.6%), 293 (24.4%) 654 (54.5%) and 33 (2.8%) belonged to classes II, III, IV and V respectively. History of tobacco use was collected and subjects were dichotomized into never users and present/past users. 471 (39.3%) were either current or past users, 729 (60.8%) had no history of tobacco use. Out of 1200 subjects only 189 (15.8%) were not on medication for diabetes. 625 (52.1%) of the subjects were diagnosed with diabetes for 3-5 years, 336 (28%) were diagnosed 6-10 years back and 239 (19.9%) were diagnosed more than 10 years back.

Table 3 shows logistic regression analysis for the extent to which the sociodemographic factors affected occurrence of dental caries. The study revealed that those of higher age, females, lower SES, greater number of years since onset of diabetes and those with uncontrolled diabetes had higher odd of developing dental caries. Table 4 shows logistic regression analysis for the extent to which the sociodemographic factors affected occurrence of periodontal pockets. The study opined that those belonging to lower socioeconomic group and those having diabetes for a longer duration were more likely to have periodontal pockets. Table 5 shows logistic regression analysis for the extent to which the sociodemographic factors affected occurrence of loss of attachment. Similar to the findings for periodontal pockets, those belonging to lower socioeconomic

group and those having diabetes for a longer duration were more likely to have loss of attachment. Table 5 shows logistic regression analysis for the extent to which the sociodemographic factors affected prosthetic need. It was seen that those with longer duration, and uncontrolled diabetes had higher odd of developing prosthetic need. Overall the results reiterated that fact that holistic care is important in diabetic patients to keep oral health conditions under check.

## DISCUSSION

The present study was conducted with the aim to determine the influence of socio-demographic factors on oral health status of Type 2 diabetics. A study conducted by JV Bharateesh *et al*<sup>7</sup>, 2012 in patients with type 2 diabetes, reported that 47% of the subjects had a CPI code of 4, this finding was similar to the present study where pockets were found in 55.2 % of the subjects. The results of the current study were also comparable to that reported by Hintao J *et al*<sup>8</sup>, 2007 in patients with type 2 diabetes, wherein the mean percentage of sites with pockets 4-5 mm and more than 6 mm were 26.4 and 6.6 respectively, these values were reported as 22.7 and 8.5 in the present study. In addition to it the mean percentage of sites with LOA more than 3 mm in the study by Hintao J *et al*<sup>8</sup> was also similar to the present study i.e. 43.8 and 39.9 percent respectively. In the present study the mean number of decayed, missing and filled teeth was 1.67, 4.72 and 0.27 respectively. The mean DMFT was 6.66. Mean number of filled teeth in the present study was very low as compared to the study conducted by Bacić M *et al*<sup>9</sup> in 1989 where it was found to be 2.2.

A study by Hintao J *et al*<sup>8</sup>, 2007 in patients with type 2 diabetes reported the mean number of decayed teeth to be 3.8 which was higher than the present study. The reason for less number of decayed teeth in the present study could be due to number of missing teeth being high and thus total number of teeth to be evaluated for caries were less in number. A similar trend was seen in a study conducted by Leung WK *et al*<sup>10</sup>, 2008 in China where the mean DMFT was high at 14.5 but the mean number of decayed teeth (2.1) was comparable to that of the present study i.e. 1.67. A study conducted by Stojanović N *et al*<sup>11</sup>, 2010 reported mean number of decayed teeth to be high at 6.5 amongst those with uncontrolled diabetes and 4.5 amongst those with controlled diabetes. The mean number of decayed, missing due to caries and filled teeth in the present study was similar to that reported by V Chandrasekhara Reddy *et al*<sup>5</sup>, 2011 in Chennai, wherein they reported mean number of decayed teeth as 1.47, missing due to caries as 0.59 and filled teeth as 0.21. The corresponding values in the present study were 1.67, 0.42 and 0.27 respectively. The mean DMFT in the said study was much lower than the present study, this may be because mean number of teeth missing due to periodontal reasons was much higher at 4.3 in the present study. JV Bharateesh *et al*<sup>7</sup>, 2012 reported the prevalence of caries in patients with diabetes as 13.6% this was much lower than that reported in the present study i.e. 52.1%. However the percentage of subjects who had at least one tooth missing (51.3%) and those who had at least one filling (11.4%) was comparable in both the studies, with JV Bharateesh *et al*<sup>7</sup> reporting it as 57.3% and 10% respectively. Limited number of studies have assessed the effect of sociodemographic variables such as SES, gender and tobacco use to oral health status. Hasan *et al*<sup>12</sup> in their study stated that poorly controlled T2DM patients had poor periodontal conditions and with long duration of T2DM to have high decayed, missed and filled

**Table 3. Logistic Regression Analysis – Influence of Covariates on Dental Caries**

Factor	Regression Co-efficient (β)	Wald	Sig.	OR (95% CI)	95% Confidence Interval	
					Lower	Upper
Age	.036	22.917	<0.001*	1.037	1.022	1.053
Gender (Ref: Male)	1.277	37.823	<0.001*	3.588	2.388	5.390
SES (Ref:Class1)				1(ref)	-	-
Class II	1.582	18.802	<0.001*	2.379	9.939	2.379
Class III	1.285	17.829	<0.001*	1.990	6.558	1.990
Class IV	1.058	13.791	<0.001*	1.648	5.037	1.648
Tobacco History (Ref: Positive History)	.301	3.635	.057	1.352	.992	1.842
Years since onset of diabetes (Ref: 3 - 5 years)				1(ref)	-	-
6 – 10 years	-.383	4.910	.027*	.682	.486	.957
>10 years	1.150	18.740	<0.001*	3.157	1.876	5.314
Control of diabetes (Ref: Well Controlled)	1.034	38.727	<0.001*	2.813	2.031	3.896

**Table 4. Logistic Regression Analysis – Influence of Covariates on Periodontal Status – Pockets**

Factor	Regression Co-efficient (β)	Wald	Sig.	OR (95% CI)	95% Confidence Interval	
					Lower	Upper
Age	-.021	14.251	<0.001*	.979	.969	.990
SES (Ref:Class1)				1(ref)		
Class II	.947	9.225	.002*	2.579	1.399	4.753
Class III	.041	.024	.878	1.042	.614	1.769
Class IV	-.195	.579	.447	.823	.497	1.360
Years since onset of diabetes (Ref: 3 - 5 years)				1(ref)		
6 – 10 years	.127	.771	.380	1.136	.855	1.510
>10 years	-.856	22.156	<0.001*	.425	.297	.607
Control of diabetes (Ref: Well Controlled)	-.257	3.873	.049*	.773	.598	.999

**Table 5. Logistic Regression Analysis – Influence of Covariates on Periodontal Status – Loss of Attachment**

Factor	Regression Co-efficient (β)	Wald	Sig.	OR (95% CI)	95% Confidence Interval	
					Lower	Upper
Age	-.078	90.335	<0.001*	.925	.911	.940
SES (Ref:Class1)				1(ref)		
Class II	.898	7.602	.006*	2.455	1.297	4.648
Class III	-1.094	12.023	.001*	.335	.181	.622
Class IV	-.941	10.313	.001*	.390	.220	.693
Tobacco History (Ref: Positive History)	.313	3.708	.054	1.368	.994	1.881
Years since onset of diabetes (Ref: 3 - 5 years)				1(ref)		
6 – 10 years	-.327	2.651	.103	.721	.486	1.069
>10 years	.222	.976	.323	1.249	.804	1.940

**Table 6. Logistic Regression Analysis – Influence of Covariates on Prosthetic Need**

Factor	Regression Co-efficient (β)	Wald	Sig.	OR (95% CI)	95% Confidence Interval	
					Lower	Upper
Age	-.045	60.163	<0.001*	.956	.946	.967
Gender (Ref: Male)	-.675	26.006	<0.001*	.509	.393	.660
Tobacco History (Ref: Positive History)	.334	6.585	.010*	1.397	1.082	1.804
Years since onset of diabetes (Ref: 3 - 5 years)				1(ref)		
6 – 10 years	.177	1.489	.222	1.194	.898	1.587
>10 years	-.265	2.425	.119	.767	.549	1.071
Control of diabetes (Ref: Well Controlled)	.383	8.943	0.003*	1.467	1.141	1.887

teeth (DMFT) values. Both these findings were reflected in the present study as well. Similarly Nikbin *et al*<sup>13</sup> in their study opined that poorly controlled diabetics had poorer oral health. Kim *et al*<sup>14</sup> also stated that CPI was significantly influenced by duration of diabetes poor control of diabetes. Faten *et al*<sup>15</sup> mentioned that lower awareness regarding oral health conditions among Diabetic patients belonging to lower socio economic status. This factor is very well seen in the present study with those belonging to lower SES showing higher odds of developing poor oral health conditions. While it is a well known fact that lack of awareness is an important factor in developing poor oral health conditions, this effect is amplified in persons with systemic conditions such as diabetes which

can inherently deteriorate oral health status as well. India is the diabetic capital of the world, in such a scenario, the dental professional play an important role in influencing diabetic patients to take better care of their oral health. Working in tandem with physician's advice is important in this regard. Awareness is the key to better oral health. Further studies with a control group for comparison is recommended to further understand the problem.

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