Correlation of oral health status among type 2 diabetic and non-diabetic adults population of Muradnagar, Ghaziabad district of India survey

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ABSTRACT

Background: Diabetes mellitus is a rising public health concern in India. It has become one of the most prevalent diseases in the world.

Aim: To assess the overall oral health conditions of the type 2 Diabetic individuals and correlate the oral hygiene, dentition, periodontal status and socioeconomic conditions among type 2 diabetes mellitus and non-diabetic individuals of Muradnagar.

Methodology: A cross-sectional comparative study was conducted among 250 Type 2 diabetic (noninsulin dependent) and 250 nondiabetic study subjects of Muradnagar block in the district of Ghaziabad from October 2019 to March 2020. The prediagnosed diabetic study subjects who visited the physician and were under treatment in the Community health centre (CHC) of Muradnagar block in Ghaziabad district whereas the non-diabetic study subjects were assessed from the outpatient department of ITS Dental College. A further extended approach was made to correlate the periodontal parameters as well as other oral health indicators and socioeconomic status among the diabetics and non-diabetic study subjects.

Results: The mean age of the diabetic study subjects was found to be 45.81 ± 5.05 years whereas of non-diabetic study subjects were 40.85 ± 7.7 years. Periodontal pocket was present among 67.2% diabetic study subjects with a mean number of teeth affected with pocket depth of about 4-5 mm in 4.68 ± 2.94 and 6 mm or more in 3.76 ± 2.83 which was comparatively higher than the non-diabetic study subjects..

Conclusion: Thus the study discusses a strong association between diabetes and deteriorated poor periodontal conditions as well as leaves an impact on the overall oral health status of the diabetic study subjects when compared to the non-diabetic study subjects.

Introduction

Diabetes mellitus is a rising public health concern in India. It has become one of the most prevalent diseases in the world. It is a metabolic disorder characterised by chronic hyperglycaemia and disturbed carbohydrate, fat and protein metabolism caused by defective insulin secretion, action or both [1]. According to the data by International Diabetes Federation (IDF) of the year 2020, 463 million people have diabetes in the world and out of them 88 million people are from the Southeast Asia region. Of this 88 million people, 77 million diabetics belong to India [2]. The probable reason for such an increased prevalence of diabetes might be due to high urbanization, industrialization and change in lifestyle patterns among the people [3]. Diabetes is also associated with a lot of medical as well as oral complications. Therefore, it is imperative to diagnose this disease at an early stage, as it will be easier to treat it effectively. It will further reduce the chances of avoiding the development of serious complications due to it [4]. Moreover the economic burden related to the management of this disease will also be reduced.

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KEYWORDS

- diabetes
- oral health status
- periodontal disease
- dental caries
- oral hygiene

There is abundant evidence that diabetes is associated with pathological changes in the oral cavity. Periodontitis is referred to as the sixth complication of diabetes mellitus [5]. In the 1997 report of the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus, periodontitis was cited as one of the pathological conditions often found in patients with diabetes [6]. Indeed, multiple studies have provided conclusive evidence that the prevalence, severity, and progression of periodontal disease are significantly increased in patients with diabetes [7]. If left untreated, periodontitis can lead to tooth loss, thereby compromising a patient's ability to maintain a proper diet and affecting the quality of life.

Other oral manifestations related to diabetes include mucosal ulceration, dry mouth, fungal infection, burning mouth syndrome, geographic tongue, oral lichen planus, fissured tongue, delayed wound healing , altered taste, impaired tooth eruption, benign parotid hypertrophy, tooth loss, xerostomia, dental caries and periodontal disease [8].

The risk factors of DM are likely to be multifactorial behavioural problems like cigarette smoking, physical inactivity, intake of saturated fatty acids and sugar-sweetened beverages etc. [9]. Socioeconomic Status (SES) is a total measure of an individual's or families economic and social position [10]. Some SES factors are also identified as risk factors having an association with DM. Specifically; the socioeconomic factors are gender, age, marital status, level of education, income, occupation, region, residential area, the amount of remaining debt and current liability. Each of these variables provides information regarding association of risks, and identifying their effects which helps us understand and address the socioeconomic inequalities in diabetes. According to a study conducted a superior SES in individuals with well-controlled T2D may have permitted them to use conventional treatments for diabetes and to maintain their oral health compared to individuals with poorly controlled T2D. Low SES is the major contributing factor in the progression of periodontal conditions in T2D. Poor education and a low socioeconomic status (SES) have been linked with a high prevalence of T2D.

However, there is no definite picture and scanty literature search for type 2 diabetes mellitus and its correlation on oral health aspects among the population in Muradnagar. Secondly as diabetes may remain undiagnosed for a long time, dentists could be instrumental in facilitating early detection of diabetes. Therefore this study was an attempt to assess the overall oral health conditions of the type 2 Diabetic individuals and correlate the oral hygiene, dentition, periodontal status and socioeconomic conditions among type 2 diabetes mellitus and non-diabetic individuals of Muradnagar.

Materials and Methods

A cross-sectional comparative study was conducted among Type 2 diabetic (noninsulin dependent) and nondiabetic study subjects of Muradnagar block in the district of Ghaziabad from October 2019 to March 2020. The prediagnosed diabetic study subjects who visited the physician and were under treatment in the Community Health Centre(CHC) of Muradnagar block in Ghaziabad district whereas the non-diabetic study subjects were assessed from the outpatient department of ITS Dental College.

The confirmed diabetic patients with physician's report were considered as diabetic. The non-diabetic study subjects were assessed for their blood glucose levels using an instant Glucometer. If the random plasma glucose level was found to be ≥ 200 mg/dL (11.1 mmol/L) which is considered to be a sign of diabetes they were referred to the physician for further confirmation of their condition and were not included in the study.

A further extended approach was made to correlate the periodontal parameters as well as other oral health indicators and socioeconomic status among the diabetics and non-diabetic study subjects.

■ Ethical clearance

Ethical committee permission-The ethical approval for the study was taken from the Ethical Committee of ITS-CDSR Muradnagar, Ghaziabad. After obtaining approval and ethical clearance of research protocol study was implemented on scheduled dates.

Medical Superintendent Permission-Prior approval was also taken from the Medical Superintendent of Community Health Centre, Muradnagar from conducting study among the diabetic patients in the centre.

Informed consent

A written informed consent in Hindi and English language was obtained from the adults before clinical examination. In case of illiterate participants, the procedure was explained verbally to the participants and then thumb prints were obtained from them prior to the conduct of the study.

Pilot study

The pilot study was carried out among 60 adult populations (30 diabetics and 30 non diabetic controls) to determine the sample size and to check the feasibility of the study. The necessary modifications were made in the data collection procedures and final proforma was designed.

Sample size determination

The sample size was estimated based on the prevalence of loss of attachment obtained from the pilot study. Sample size was calculated using this formula Substituting the Z α/2 value for 5% level of significance and Zβ value for 80% power of the study:

• Zα=1.960

• Zβ=0.84

• P1=Prevalence of loss of attachment among diabetic study subjects: 38%

• P2=Prevalence of loss of attachment among non-diabetic study subjects: 26%

Which gives a value of n=234 study subjects rounded off to 250 study subjects. Accordingly, 250 diabetics and 250 non diabetics were recruited into the study with a total sample size of 500 study subjects.

Inclusion criteria for enrolment

1. Diagnosed with T2D more than one year ago.

2. No medication with antibiotics or steroidal and/or non-steroidal anti-inflammatory agents over the past 3 weeks.

3. At least 16 remaining natural teeth.

4. No immunosuppressive chemotherapy, no current acute illness, no professional periodontal treatment during the last 6 months and no pregnancy or lactation.

For non-diabetic individuals-With the exception of a diagnosis of diabetes, the same selection criteria as above were applied to recruitment of study subjects without diabetes. The random blood glucose levels of the study subjects without diabetes were assessed using an instant Glucometer. If found diabetic that is random blood glucose levels ≥ 200 gm/dl by the assessment, they were not included in the study and were referred to a physician.

Exclusion criteria

• Edentulous subjects were excluded from the study.

• Study subjects with any other systemic diseases like hypertension, epilepsy, which can inhibit the clinical examination were excluded.

• Study subjects on antimicrobial medication and had undergone any periodontal therapy during past 6 months were excluded from the study

An interview based questionnaire was administered to collect data from the study subjects. The questionnaire was basically divided into two parts. The first part assessed the basic demographic details of the study subjects. Apart from that the body mass index of the study subjects was also calculated. Socioeconomic status of the study subjects were also evaluated using modified Kuppuswamy Scale 2019 *via* reframing the socioeconomic classes as per Ministry of Labour and Employment, Consumer Price Index. Whereas, the second part assessed the study subject's basic knowledge on diabetes, their family history of diabetes, type and duration of diabetes, their knowledge on the systemic as well as oral manifestations of diabetes and also about their medication history due to diabetes.

Clinical examination

A WHO Oral health Assessment questionnaire 2013 was used to assess the risk and protective factors for individual's oral health outcomes as well as the frequency of personal oral hygiene practices, tobacco use history, past dental visits, their quality of life, frequency of sugar intake, alcohol use etc among the study subjects. A single trained and calibrated investigator (Kappa value=0.84 for intra-rater examination) conducted the clinical examination by recording Oral Hygiene Index–Simplified (OHI-S) was used to determine oral hygiene and Community periodontal index16 using WHO Oral health 2013 criteria.

Statistical analysis

Data was analysed using the SPSS v16.0 software package. Descriptive statistics were addressed such as mean, percentage and standard deviation.

Association was evaluated using Chi square. Any p value less than 0.05 was considered significant. Spearman correlation rank test was also assessed to correlate. Independent sample t test is applied to unpaired data of independent observations made on individuals of two different or separate groups or samples drawn from two populations. Multinomial logistic regression is used to predict a nominal dependent variable given one or more independent variables.

Results

The sociodemographic details of both diabetic and non-diabetic study subjects who were included in the study were described in **TABLE 1.** The mean age of diabetic study subjects is 45.81 ± 5.05 years whereas of non-diabetic study subjects are 40.85 ± 7.7 years. A majority 157 (62.8%) diabetic study subjects were males and 93 (37.2%) were females whereas among non-diabetic study subjects, a majority 162 (64.8%) subjects were males and 88 (35.2%) were females. A statistically significant difference was found between diabetic and non-diabetic study subjects and their socioeconomic status and body mass index and family history of diabetes. (p value ≤ 0.05) (**TABLE 1**).

TABLE 1: Distribution of demographic details among the diabetic and non diabetic study subjects.

Age (years)	Diabetic n(%)	Non-Diabetic n(%)
18-27 years	0 (0%)	0 (0%)
28-37 years	11(4.4%)	58 (23.2%)
38-47 years	88 (35.2%)	146 (58.4%)
48-57 years	149 (59.6%)	46 (18.4%)
Above 58 years	2 (0.8%)	0 (0%)
Total	250(100%)	250(100%)
Gender		
Males	157 (62.8%)	162 (64.8%)
Females	93 (37.2%)	88 (35.2%)
Total	250 (100%)	250 (100%)
Marital status		
Married	232 (92.8%)	222 (88.8%)
Unmarried	18 (7.2%)	28 (11.2%)
Total	250 (100%)	250 (100%)
Location		
Urban	49 (19.6%)	49 (19.6%)
Semiurban	162 (64.8%)	172 (68.8%)
Rural	39 (15.6%)	29 (11.6%)
Total	250 (100%)	250 (100%)
Body mass index		
Underweight	46(18.4%)	66 (26.4%)
Healthy/normal	69(27.6%)	103(41.2%)
Overweight	55(22%)	51(20.4%)
Obese	80(32%)	30 (12%)
Total	250(100%)	250 (100%)
Education		
Profession/ honours	2(0.8%)	1(0.34%)
Graduate	3(1.2%)	3(1.2%)
Intermediate/ diploma	38(15.2%)	32(12.8%)
High school certificate	35(14%)	33(13.2%)
Middle school certificate	60(24%)	96(38.4%)
Primary school certificate	83(33.2%)	62(24.8%)
Illiterate	29(11.6%)	23(11.6%)
Total	250(100%)	250 (100%)
Occupation		
Legislatures or senior lecturers	0(0%)	0(0%)
Professionals	0(0%)	1(0.4%)
Technicians and associate professionals	2(0.8%)	2(0.8%)
Clerks	13(5.2%)	4(1.6%)
Skilled workers and shop and market sale workers	18(7.2%)	7(2.8%)
Skilled agricultural and fishery workers	12(4.8%)	20(8%)
Craft and relatable trade workers	36(14.4%)	56(22.4%)
Plant and machine operators and assemblers	75(30%)	98(39.2%)
Elementary occupation	56(22.4%)	44(17.6%)
Unemployed	38(15.2%)	18(7.2%)
Total	250(100%)	250 (100%)
Family income		
>78063	0(0%)	1(0.4%)
39033-78062	10(4%)	8(3.2%)
29200-39032	22(8.8%)	13(5.2%)
19516-29199	43(17.2%)	52(20.8%)
11708-19515	49(19.6%)	67(26.8%)
3908-11707	77(30.8%)	89(35.6%)
<3907	49(19.6%)	20(8%)
Total	250(100%)	250 (100%)
Socioeconomic status		
Upper	3 (1.2%)	4 (1.6%)
Upper middle	11 (4.4%)	7 (2.8%)
Lower middle	30 (12%)	59 (23.6%)
Upper lower	113 (45.2%)	156 (62.4%)
Lower	93 (37.2%)	24 (9.8%)
Total	250(100%)	250(100%)
Family history of diabetes		
Absent	89 (35.6%)	149 (59.6%)
Present	161 (64.4%)	101 (40.4%)
Total	250(100%)	250(100%)

TABLE 2 states that among the diabetic study subjects, a majority 103(41.2%) had diabetes for more than 8 years, 224 (89.6%) were under medication for diabetes either oral or injectables, 168(75%) diabetic study subjects used oral medications as a treatment modality to keep diabetes under control and 122(48.8%) diabetic study subjects surfed internet as a source of information for diabetes apart from their physician (TABLE 2).

TABLE 2: Distribution of diabetic study subjects based on their duration, treatment, type of treatment modality and source of information about diabetes.

Duration	Study subjects n (%)
Less than 2 years	20 (8.0 %)
2 years- 5 years	65 (26.0%)
5-8 years	62 (24.8%)
More than 8 years	103 (41.2%)
Total	250 (100.0)
Treatment	
Under medications	224 (89.6%)
Not under medications	26 (10.4%)
Total	250 (100%)
Type of treatment modality	
Injectables	56 (25%)
Oral	168 (75%)
Total	224 (100%)
Source of information	
Internet	122 (48.8%)
Friends/family	88 (35.2%)
Newspaper	11 (4.4%)
TV/radio	26 (10.4%)
Books	3 (1.2%)
Total	250(100%)

Considering the responses to assess the knowledge among the study subjects a statistically significant difference was found between the diabetic and non-diabetic study subjects and their knowledge about the various effects of diabetes on general health as well as oral health and the increasing risk of the same to cause gum disease (P value ≤ 0.05) (TABLE 3).

TABLE 4 describes the comparison of oral hygiene behaviours and practices of diabetic and non-diabetic study subjects which was statistically significant when compared to non-diabetics (p value ≤ 0.05). A non-significant difference was observed among diabetic and non-diabetic study subjects when compared to the cleaning aids used for cleaning their teeth (P value 0.06) (TABLE 4).

The mean dentition status of both the study group that is diabetes and non-diabetes group was recorded. It was noted that the mean number of sound teeth of the diabetic study subjects were 21.62 ± 4.73, carious were 2.68 ± 1.84, filled with caries were 0.98 ± 1.64, filled with no caries were 1.09 ± 0.81, missing due to any other reason were 3.16 ± 3.32 and fixed dental prosthesis/abutment were 0.16 ± 0.47 which had a statistically significant difference when compared to the non-diabetics whereas missing due to caries (2.32 ± 2.7) were found to be statistically non-significant among both the groups.

The mean DMFT (Decayed Missing Filled Teeth) status is statistically significantly higher among diabetics (10.23 ± 4.73) than non-diabetics (10.23 ± 4.73). The mean number of teeth with periodontal pocket depth of 4-5 mm was noted as 4.68 ± 2.94 among the diabetic study subjects whereas among non-diabetic study subjects were 1.75 ± 2.14. The mean number of sextants affected with loss of attachment score 0-3 mm (2.39 ± 0.88), 4-5 mm (1.72 ± 0.79), 6-8 mm (1.37 ± 0.656), 9-11 mm (0.20 ± 0.465) and 12 mm or more (0.16 ± 0.486) were comparatively statistically significant and higher among the diabetic study subjects (P value 0.815) (TABLE 5).

TABLE 3: Knowledge about oral and general health effects of diabetes among the study subjects.

Responses	Diabetic n (%)			Non diabetic n (%)			p-value	Significance
	Yes n(%)	No n(%)	Don't know	Yes n(%)	No n(%)	Don't know		
Q1. Do you know the effect of diabetes on general health?	110	140	-	147	103	-	0.001	Significant
	-44%	-56%		-58.80%	-41.20%			
Q2. Do you know the effect of Diabetes on oral health?	108	142	-	73	177	-	0.001	Significant
	-43.20%	-56.80%		-29.20%	-70.80%			
Q3. Are Diabetic patients prone to dental caries?	44	83	123	24	92	134	0.33	Not
	-17.60%	-33.20%	-49.20%	-9.60%	-36.80%	-53.60%		
Q4. Does Diabetes have an increased risk of developing gum disease?	93	121	53	69	104	60	0.007	Significant
	-37.20%	-48.40%	-21.20%	-27.60%	-41.60%	-24%		

TABLE 4: Comparison of responses of the study subjects based on their oral hygiene behaviours.

Responses	Diabetic n(%)	Non Diabetic n(%)	Chi-square value	p-value	Significance
Never	9 (3.6%)	5 (2%)	10.033	0	Significant
Once a month	9 (3.6%)	3 (1.2%)			
2-3 times a month	8 (3.2%)	3 (1.2%)			
Once a week	3(1.2%)	10(4%)			
2-6 times a week	0 (0%)	23(9.2%)			
Once a day	150 (60%)	198 (79.2%)			
Twice or more a day	71 (28.4%)	8 (3.2%)			
Total	250 (100%)	250 (100%)			
Oral hygiene aids					
Toothbrush and toothpaste	202 (80.8%)	209 (83.6%)	5.717	0.06	Non- significant
Wooden toothpicks	3 (1.2%)	6 (2.4%)			
Plastic toothpicks	4 (1.6%)	5 (2%)			
Charcoal	1 (0.4%)	6 (2.4%)			
Chewstick/ miswak	30 (12%)	20 (8%)			
Others, specify	10 (1.6%)	10 (4%)			
Total	250(100%)	250(100%)			

TABLE 5: Comparison of mean dentition status among diabetic and non-diabetic study subject.

	Diabetic (Mean ± SD)	Non- Diabetic (Mean ± SD)	t-value	df	p-value	Significance
Dentition status						
Sound	21.62 ± 4.73	26.49 ± 3.274	13.37	443	0	Significant
Caries	2.68 ± 1.84	0.86 ± 1.3	-12.72	449	0	Significant
Filled with caries	0.98 ± 1.64	0.44 ± 1.01	-4.434	414	0	Significant
Filled with no caries	1.09 ± 0.81	0.51 ± 0.72	-8.42	498	0	Significant
Missing due to any other reason	3.16 ± 3.32	1.26 ± 1.53	-8.23	351	0	Significant
Missing due to caries	2.32 ± 2.7	2.26 ± 2.64	-0.235	498	0.815	Non-Significant
Fixed dental prosthesis/ abutment/ implants	0.16 ± 0.47	0.18 ± 0.51	0.45	498	0.425	Non-Significant
Decayed, missing and filled teeth teeth and mean DMFT status						
Decayed	3.66 ± 2.69	1.30 ± 1.696	-11.773	420	0	Significant
Missing	5.48 ± 4.02	3.53 ± 3.229	-5.99	477	0	Significant
Filled	1.09 ± 0.81	0.51 ± 0.729	-8.421	498	0.01	Significant
DMFT status	10.23 ± 4.73	5.34 ± 3.316	-13.391	447	0	Significant
Periodontal pocket depth						
4-5 mm	4.68 ± 2.94	1.75 ± 2.14	-12.7	456	0	Significant
6 mm or more	3.76 ± 2.83	0.59 ± 1.44	-15.76	370	0	Significant
Loss of attachment						
0-3 mm	2.39 ± 0.88	1.19 ± 0.447	-13.658	220.958	0	Significant
4-5 mm	1.72 ± 0.79	0.84 ± 0.504	-11.927	229.999	0	Significant
6-8 mm	1.37 ± 0.656	0.36 ± 0.256	-10.989	198.605	0	Significant
9-11 mm	0.20 ± 0.465	0.03 ± 0.235	-3.547	220.644	0	Significant
12 mm or more	0.16 ± 0.486	0.04 ± 0.256	-2.405	223.559	0.017	Not significant

The prevalence of gingival bleeding among diabetic study subjects in the present study is noted as 33.4% whereas among non-diabetic study subjects is 23.8%. The overall prevalence of gingival bleeding among the study subjects is found to be 57.2%. The prevalence of periodontal pocket formation among diabetic study subjects was observed as 33.6% whereas among non-diabetic study subjects was 21.8%. The overall prevalence of periodontal pocket formation among the study subjects is about 55.4%. The periodontal pockets were seen among a majority 168(67.2%) diabetic study subjects and subsequently absence of periodontal pocket. were seen in 82(32.8%) diabetic study subjects whereas among the non-diabetic study subjects, periodontal pockets were seen among a majority 109(43.6%) study subjects and subsequently absence of periodontal pocket were seen in 141(56.4%) study subjects. The prevalence of attachment loss in the present study among the diabetic study subjects was noted as 28.4% whereas among the non-diabetic study subjects was 18%. The overall prevalence of clinical attachment loss in the study population is 46.4%. On comparison of the overall mean oral hygiene index scores among both the study groups, it was noted that the mean debris index score were 1.87 ± 0.59, mean calculus index scores were 1.90 ± 0.56 and the mean oral hygiene simplified index scores were 3.77 ± 1.09 among the diabetic study subjects which is statistically significant and higher when compared to non-diabetics.

A statistically significant difference was found among diabetic and non-diabetic study subjects and gingival bleeding, periodontal pocket formation, loss of attachment (P value ≥ 0.05) (**TABLE 6**). Multinomial logistic regression depicts that non diabetic study subjects are 1.27 times (OR 1.27, 95% CI 0.77-2.09) more likely to not have periodontal pocket than diabetic study.

subjects, underweight study subjects are 1.07 times more likely to not have periodontal pocket (OR 1.0657, 95%CI 0.553-2.059) than obese study subjects, overweight study subjects are 0.953 times less likely to not have periodontal pocket than obese study subjects, study subjects with lower socioeconomic class 0.047 times (OR 0.047, 95%CI 0.503-1.803) less likely to not have periodontal pocket than the upper socioeconomic status class, the study subjects in the age group 28-37 years are 4.76 times (OR 4.76, 95%CI 2.185-1.03) and in the age group 38-47 years 1.03 times (OR 1.03, 95%CI 6051604-1.75) more likely to have absence of periodontal pocket than the study subjects in the age group above 57 years (**TABLE 7**).

TABLE 6: Comparison of gingival bleeding among diabetic and non-diabetic study subjects.

	Diabetics n(%)	Non diabetic n(%)	Chi square value	p-value	Significance
Gingival bleeding					
Present	167(66.8%)	119(47.6%)	18.822	0	Significant
Absent	83(33.2%)	131 (52.4%)			
Total	250(100%)	250(100%)			
Periodontal pocket					
Present	168(67.2%)	109(43.6%)	28.177	0	Significant
Absent	82(32.8%)	141(56.4%)			
Total	250(100%)	250(100%)			
Loss of attachment	Diabetic n(%)	Non-Diabetic n(%)			
Present	142(56.8%)	90(36%)	21.75	0.002	Significant
Absent	108(43.2%)	160(64%)			
Total	250(100%)	250(100%)			
Oral hygiene index simplified index					
Good	14(5.6%)	16(6.4%)	30.499	0	Significant
Fair	197(78.8%)	142(56.8)			
Poor	39(15.6%)	92(36.8%)			
Total	250(100%)	250(100%)			

TABLE 7: Multinomial logistic regression of periodontal pocket among the study subjects.

	Regression coefficient	Standard error	Wald	Significance	Exp (B)	95% confidence Interval	
						Lower bound	Upper bound
Periodontal pocket							
Intercept	-15.633	0.744	440.95	0	-	-	-
Condition							
Non-diabetes	0.238	0.255	0.869	0.351	1.268	0.77	2.09
Diabetes	0b	-	-	-	-	-	-
Body Mass Index (BMI)							
Under weight	0.065	0.335	0.038	0.846	1.067	0.553	2.059
Normal	0.713	0.317	5.059	0.024	2.04	1.096	3.797
Overweight	-0.048	0.325	0.022	0.882	0.953	0.503	1.803
Obese	0b	-	-	-	-	-	-
Socioeconomic status							
Lower	-2.706	0.796	11.551	0.001	0.067	0.014	0.318
Upper lower	-1.255	0.744	2.849	0.091	0.285	0.066	1.224
Lower middle	-0.587	0.742	0.626	0.429	0.556	0.13	2.381
Upper middle	-1.238	0.777	2.54	0.111	0.29	0.063	1.329
Upper	0b	-	-	-	-	-	-
Age category							
Age(28-37 years)	17.679	0.398	1.975 E3	0	47640000	21850000	1.039 E8
Age(38-47 years)	16.147	0.271	3.544 E3	0	10300000	6051604.121	1.753 E7
Age(48-57 years)	16.211	0	-	-	10970000	10970000	1.097 E7
Age(above 57 years)	0b	-	-	-	-	-	-

Note: a. The reference category is present; b. This parameter is set to zero because it is redundant.

Discussion

It is said that having a medical condition can increase the risk of contracting other health issues in the body as well. Diabetes lies to be a perfect example of it. Oral implications are the major complication of diabetes which needs to be treated in an early go. The present cross sectional study is assessing the correlation between socioeconomic and periodontal parameters among diabetic and non-diabetic study subjects. An extended approach is also made to assess their oral hygiene habits and oral health status as well.

In the present study, diabetic study subjects with the mean age of 45.81 ± 5.05 years who visited the Community health centre and non-diabetic study subjects with a mean age of 40.85 ± 7.7 years who have visited the dental hospital from various parts of Muradnagar were assessed. They represented a considerable fraction of both men and women of Muradnagar as a majority of them visited these health care settings.

The majority of study subjects in the present study were males among both the diabetic (62.8%) and non-diabetic group (64.8%) which is similar to a study done by Bharateesh where females were 39% and the males were 61% in the study population. A total of 64.4% of diabetic study subjects had a positive history of diabetes in their family which is similar to a study done at Tamil Nadu by Geetha. The probable reason for this is that diabetes is a disease which has a strong clustering in families and has a genetic component. The risk of developing Type 2 Diabetes mellitus increases approximately two to

four folds when one or both parents are affected. Thus, family history of diabetes may be a useful tool to identify the individuals at increased risk of developing the disease and target behaviour modifications that could potentially delay disease onset and improve health outcomes.

A majority 41.2% of the study subjects reported diabetes for more than 3 year duration. A study by Ojehanon conducted at Nigeria reported about three-tenth (30.6%) of the participants had suffered diabetes for more than 10 years. This indicates that diabetes is a lifelong complication which may remain silent and undiagnosed/ unnoticed for a long period of time. Thus the term silent killer is best suited to this disease.

In the present study, a majority 32% of the diabetic study subjects were obese. This is comparable to a study done at Nepal where BMI was found to be higher (obesity) in diabetics as compared to non-diabetics. This contributes to the notion than obesity may be an etiologic factor in development of diabetes mellitus. These factors are most closely associated with diabetes which includes dietary modifications, extent of physical activity that is a sedentary lifestyle and genetic susceptibility.

A majority of 56.8% diabetics and 70.8% non-diabetics did not know about the effects of diabetes on oral health which is similar to a study done by Mubayrik. A study done by Arunkumar measured patient knowledge and awareness concerning the effects of Diabetes on oral health and found that only 10.8 per cent of the study participants were familiar with the effects of diabetes on oral health and only 13 per cent had been provided with information by their dentist concerning the risks of oral complications and the importance of regular dental care.

The present study revealed not much significant difference in oral hygiene practices among diabetic and non-diabetic study subjects. A majority of diabetic (80.8%) and non-diabetic (83.6%) study subjects used toothbrush and toothpaste to clean their teeth followed by use of chewstick/ neemstick. Comparable results are found from a study conducted where only 80% of the study population used toothbrush and paste to clean their teeth. This may be due to the fact that the present study is conducted in a semiurban area where most of them use toothpaste and toothbrush and growing awareness about use of the proper oral hygiene aid through various oral health programs conducted at the health centres as well as through media. Majority of the diabetic (60%) as well as non-diabetic study subjects (79.2%) in the present study brushed their teeth only once a day and only 28.4% of the diabetics brushed their teeth twice daily. Similar findings are seen in a study conducted in Finland where only 38% brushed their teeth twice and another study conducted in Jeddah showed that 46% of the study subjects brushed their teeth more than once a day. Considering the results of the present study, emphasizing proper tooth brushing methods and frequency is particularly important among the adult population of Muradnagar.

Duration of diabetes is considered as a main factor when addressing the susceptibility to periodontal disease and other systemic complications but control of glycemia is one of the principal etiologic mechanisms associated with periodontal breakdown. Thus the study discusses a strong association between duration of diabetes and periodontal as well as loss of attachment. One of these studies conducted and concluded that the duration of diabetes was a significant factor for the severity of periodontal disease.

The mean number of carious lesions were higher among the diabetic study subjects(2.68 ± 1.84) compared to the non-diabetic group.(0.86 ± 1.3) Diabetic patients may have more frequent meals than normal subjects and repeated intakes of even small amounts of carbohydrates may be cariogenic. A study conducted by Lalla produced similar results where the mean number of carious lesions was identical in both the groups but the non-diabetic control group had significantly more teeth with restorations.

The mean number of filled teeth was higher in diabetic study subjects (1.09 ± 0.81) compared to non-diabetic study subjects depicting higher oral treatment needs and debilitating oral conditions in them. Contradictory results were shown by a study done by Puranik where the mean number of filled teeth was higher in non-diabetics compared to the diabetic group.

The mean number of teeth missing due to other reasons was slightly higher among diabetics (3.16 ± 3.32) than non-diabetics in the present study. The "other reason" considered in this study was missing due to periodontal conditions. Although the mean number of missing teeth does not give a direct insight into the periodontal status, it is an important factor in estimating oral health.

In the present study the mean DMFT status was 8.99 ± 5.27 for diabetic and 3.67 ± 3.10 for

non-diabetic study subjects. This is similar to a study done by Sukminingram where the mean DMFT was 13.52 ± 3.694 in diabetic group, significantly higher (P<0.05) than 9.73 ± 2.496 in the non-diabetic group. In contrast, Pohjamo reported only fewer decayed teeth in adults with diabetes compared to controls. A possible explanation for these findings might be due to loss of protective mechanism of the saliva in diabetics. The cleansing and buffering action of saliva is also impaired. Low salivary pH promotes the growth of aciduric bacteria which then allows the acidogenic bacteria to proliferate creating an inhospitable environment for the protective oral bacteria. This allows for a shift in the oral environmental balance to favour cariogenic bacteria, which further lowers the salivary pH and the cycle continues.

This is surprising in view of the fact that the lower intake of refined carbohydrates, especially sucrose, and high protein content of the diet make the dietary habits of diabetic subjects clearly less cariogenic than among non-diabetics. This finding, therefore, raises the question as to why adult diabetics develop as many new carious lesions as their healthy counterparts in spite of the restricted diet. Diabetic patients may have more frequent meals than normal subjects and repeated intakes of even small amounts of carbohydrates may be cariogenic.

In the present study a majority 67.2% of the diabetic study subjects reported with presence of periodontal pocket compared to the non-diabetic study subjects (43.6%). Comparable results are shown by a study done by Botero where the proportion of periodontitis was higher (75.3%) in patients affected by diabetes than in patients without diabetes (64.1%). Apart from that the effect of diabetes on periodontal tissues has been also thoroughly investigated in various observational studies in the past demonstrating that diabetes is associated with exaggerated periodontal tissue destruction. A 5-year follow-up study demonstrated that periodontal tissue destruction is associated with poor glycaemic control (HbA1c ≥ 6.5%) (48 mmol/mol) of 2.9.

Diabetic study subjects had a higher mean number of 4.68 ± 2.94 teeth with pocket 4-5 mm and 11 ± 5.95 with pocket 6 mm or more compared to non-diabetics with pocket 4-5 mm (1.75 ± 2.14) and pocket 6 mm or more (0.59 ± 1.44). The results are slightly comparable to a study done by Kesavan stated that the mean number of teeth with shallow pockets (4-5 mm) was 0.76 ± 1.20 among diabetics and 0.49 ± 0.86 among non-diabetics [3]. The mean number of sextants with deep pockets (pocket 6 mm or more) was 0.06 ± 0.39 among diabetics and 0.02 ± 0.20 among non-diabetics, which was statistically significant. Logistic regression model analysis of risk factors for chronic periodontitis among the study subjects revealed that diabetes (Odds ratio: 1.268) is a significant risk factors for periodontitis. Individuals with a low socioeconomic status also had a higher prevalence of periodontitis than those with higher socioeconomic status which is comparable to a study done by Nand where the odds ratio was 3.19 (95% CI: 1.00–10.12) among the study subjects.

The presence of loss of attachment was seen in 36% diabetic and 56.8% non-diabetic study subjects. Similar findings were observed in studies conducted among other populations. But a study conducted by Collin showed no significant difference in loss of attachment scores among diabetics and nondiabetic study subjects. Patients with diabetes along with periodontitis presented an increased periodontal loss of attachment as compared to patients without diabetes. Nevertheless, the diagnosis of periodontal disease results from the analysis of periodontal disease and attachment loss that represents past destruction of periodontal tissues, and this constitutes one of the main causes of tooth loss.

Most of the people in India have a perception that dentistry is an expensive means which keeps them away from registered professionals on one hand, while on the other hand turning them into hostages to services of nonregistered lay practitioners sitting on the streets. The main reason behind this is the low level of awareness regarding oral health and hygiene. The oral hygiene status was slightly poorer among diabetics when compared to nondiabetics which are comparable to a study conducted by Hintao where nondiabetics had better oral health status. This might be due to improper removal of dental plaque and debris which adheres to the tooth surface and gingiva leading to caries and gingival inflammation.

Thus the study discusses a strong association between diabetes and deteriorated poor periodontal conditions as well as leaves an impact on the overall oral health status of the diabetic study subjects when compared to the non-diabetic study subjects. Apart from that there are

various risk factors detected in the present study like socioeconomic status, body mass index, and duration of diabetes which eventually leads to poor oral health outcomes among the study subjects.

Conclusion

Diabetes and its impact on oral health status is just a mere beginning to be explored. There is an utmost need of further research in this regard to understand the implication of such common systemic manifestations in the oral cavity of an individual. Therefore active efforts with a focus on primary prevention for chronic dental diseases should always be the prior duty of an individual to control the burden of noncommunicable diseases like Diabetes in India.

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