



Effect of oral health education on dental caries and periodontal health status of diabetic patients in Calabar metropolis

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Abstract

Context: Dental caries and periodontal disease are complications of Diabetic Mellitus (DM) which can result in tooth loss and most diabetes are unaware of these effects. This study aims to determine the effect of oral health education among DM patients

Materials and method: This was a quasi-experimental/interventional study carried out at the University of Calabar Teaching Hospital, Nigeria. Study participants were drawn from DM patients attending diabetic clinic of the hospital. Ethical approval was gotten from the ethics committee of the hospital (Number UCTH/HREC/008/094). Written and informed consent was obtained from all participants. At baseline the mouth of each participant was examined for decay, missing and filled teeth using DMFT index while the periodontium was examined for periodontal disease using Gingival Bleeding Index by Ainamo and Bay and Periodontal Disease Index by Ramfjord. Oral hygiene instructions were then given to each participant and follow up was done at 2wks, 4wks, 6wks and 8wks.

Results: A total of 96 participants who met the inclusion criteria participated in this study. Females were 63 (66.0%) and males 33 (34.0%). The most common age group was 55 to 64yrs (42.7%). Most of the participants (39.6%) had DM for over 10years while 72 (75.0%) had family history of DM. There was a statistically significant difference in the mean gingival bleeding index of participants at baseline (25.28+/-9.88) and post oral education at 2,4,6 and 8 weeks (14.43+/-3.18, 4.43+/-0.93, 0.68+/-0.05 and 0.00+/-0.00 respectively; $p<0.001$). The mean periodontal disease index also differed significantly at baseline (0.68+/-0.078) and post oral education at 2,4,6,8 weeks (0.56+/-0.058; 0.23+/-0.097; 0.24+/-0.03 and 0.02+/-0.00 respectively; $p=0.000$)

Conclusion: Proper oral health education can significantly reduce dental caries and periodontal disease among DM patients. Hence oral health education sessions should be strongly implemented in diabetic and dental clinics.

Key Words: Dental caries, Periodontal disease, Diabetes mellitus, Oral health education

Introduction

Diabetic mellitus (DM) is a chronic disease in which the body's ability to produce or respond to the hormone insulin is impaired, resulting in abnormal metabolism of carbohydrates and elevated levels of glucose in the blood.^{1,2} This disease affects virtually all the various organs of the body including the teeth

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and its supporting structures.^{1,2} DM is a burden on those suffering from this disease condition, as most affected persons who are unable to manage the disease may end up losing their lives as a result of the complications developed from it.^{2,3,4} The need to maintain good glycemic control cannot be overemphasized as this helps to reduce the impact

of this disease condition on the organs of the body, thus prolonging the lifespan of the affected individual.^{1,4,5}

Dental caries (DC) and periodontal disease are oral complications of DM which can result in tooth loss; thus, these patients present in the dental clinic for filling of carious teeth or replacement of missing teeth.^{1,3,6} Dental caries and tooth loss affect the quality of life of those suffering from this disease condition which further complicate the impact of DM on affected individuals.⁷ DM affect the major salivary gland which result in decrease production of saliva. Decrease salivary flow leads to increase accumulation of Plaques and calculus which predisposes Diabetes to developing dental caries and periodontal disease, thus increase in tooth loss.^{2,3,7}

Studies^{8,9} has showed that most diabetics are unaware of the effect of DM on their oral health and are more knowledgeable of the effect on other organs of the body. This situation results in inadequate preparedness to practice proper preventive oral care and management of oral complications from diabetes mellitus.⁴ The need for diabetic patients to maintain good oral hygiene cannot be over emphasized as studies^{1,2,3} have showed that maintenance of good oral hygiene among diabetic patients helps to reduce the effect of this disease condition on the oral tissue. Therefore, Maintenance of good oral hygiene, adequate glycemic control and early restoration of carious tooth in DM patients help to prevent tooth loss, thereby prolonging the life span of natural tooth in the mouth.^{3,6} As there is an increase in the number of persons affected by DM, so there is an increase in the numbers who present at dental offices requesting for restoration of their carious tooth or replacement of their missing teeth.⁷ This increase may not be unconnected with lack of knowledge that DM affects various organs of the body including the standing teeth and its supporting structures. More so, lack of knowledge of early restoration of carious tooth, replacement of missing tooth and maintenance of good oral hygiene may further increase the number of tooth loss and decrease the quality of life of DM patients.

Therefore, in order to reduce the oral complications of DM thereby reduce the disease burden, proper education of the effect of DM on oral tissues and

their early management is very important^{10,11} as there is a limited knowledge among diabetics of the effect of DM on standing teeth, restoration of carious teeth and replacement of missing teeth.^{3,7} The aim of this study is to determine the effect of the knowledge of oral health education among diabetic patients in Calabar metropolis

Materials and Method

Study Setting and Location: This study was conducted among diabetic patients attending diabetic clinic at the University of Calabar Teaching Hospital, Calabar, in Cross River State, south-South Nigeria, Sub-Sahara Africa. The hospital runs diabetic clinic were old and newly diagnosed diabetic patients comes for treatment and an average of fifty to sixty patient is seen on each clinic day. The university of Calabar teaching Hospital is the only teaching hospital in Cross River State where there are different specialties. The Hospital serves as a major referrer center for patients within the state and neighboring state.

Study design: This was an interventional study where oral health education was given to each participant as an interventional measure and the effect of this education on their oral health was monitored using oral health indices. Ethical approval was obtained from the Ethics Committee of the University of Calabar Teaching Hospital, Calabar, Nigeria, before the commencement of the study (Number UCTH/HREC/008/094).

Sampling Method: At the point of registration at the diabetic clinic, each patient was given a number. Participants were recruited from the first thirty patients each day using a simple random sampling technique by balloting. Oral and written informed consent was obtained from all participants. Selected participants were screened for eligibility by set inclusion and exclusion criteria and those that met these criteria and willing to give informed consent were included in the study

Sample size: The sample size was calculated using the formula:¹²

$$n = Z^2 \cdot p \times (1 - P) / d^2$$

Where n=Sample size, the standard normal deviate,

usually set at 1.96 which corresponds to the 95% confidence level, $P=$ this was based on a prevalence of 5.77% of DM reported in a study in Nigeria.⁶

d = an absolute error of 5%

$n = 1.96^2 \times 0.058 \times 0.94 / 0.0025 = 88$ patients

10% increase which is 8 participants was added to allow for attrition making a minimum sample size of 96 patients.

Inclusion and Exclusion Criteria: Inclusion criteria were; diagnosed DM patients, DM patients with or without dental caries, DM patients with or without periodontal disease and DM patients who gave informed consent. Exclusion criteria were DM patients using dental prosthesis and DM patients who refuse to give informed consent.

Data collection and data collection tools: At baseline, intra oral examinations were done for carious teeth, filled teeth, missing teeth, gingival bleeding and periodontal disease using hand gloves, mouth mirror, dental probe and tongue depressor. The Decay (D), missing (M) and filled (F) teeth were scored using the DMFT index, gingival bleeding was scored using Bleeding on Probing Index by Ainamo and Bay (1975)¹³ while periodontal disease was scored using Periodontal Disease Index by Ramfjord (1956)¹⁴.

1. DMFT index: Decay, missing and filled teeth were examined using this index. Carious tooth was given a score of 1 and the number of decayed teeth was added together, missing tooth was given a score of 1 and the number of missing teeth were added together and filled tooth was given a score of 1 and the number of filled teeth were also added together.
2. Gingival Bleeding Index by Ainamo and Bay (1975): In this index, gentle probing of gingival crevices was done with blunt periodontal probe. If the bleeding occurs in 10-15 seconds it is considered as positive. The number of positive sites were recorded and then expressed as a percentage of the number of sites examined.
3. Periodontal disease index by Ramfjord (1956): The periodontal disease index (PDI) of Ramfjord has gingival and periodontal component:

a. Determining gingival status:

The gingiva was first dried with cotton pellets and any color change was noted.

The scoring criteria include the following:

0. absence of signs of inflammation

1. Mild to moderate inflammatory gingival changes, not extending around the tooth
2. Mild to moderately severe gingivitis extending all around the tooth
3. Severe gingivitis characterized by marked redness, swelling, tendency to bleed and ulceration, not necessarily extending around the tooth.

b. Determining the crevice depth:

Michigan O probe was used to obtain consistent readings. Four measurements were taken i.e. facial, lingual, mesial and distal. The cemento-enamel (CEJ) junction was first located with a probe tip and then measure distance from gingival margin. The probe was then used to measure the pocket depth from gingival margin to attached periodontal tissue. The initial measurement was subtracted from the later. Meanwhile, when there was apparent recession, the direct reading from the CEJ to attached periodontal tissue was measured.

Scoring criteria:

0-3 is gingival index.

4. Four recorded areas extend apically to the CEJ not more than 3mm, but including 3mm
5. Four recorded areas extend apically to the CEJ from 3mm-6mm
6. Four recorded areas extend apically more than 6mm from CEJ

Individual score was gotten by adding all the scores for all teeth and dividing it by the total number of teeth examined.

Self-administered questionnaire was used to obtain the following information: gender, age, level of education, occupation, duration of DM, knowledge of type of tooth restorative material, family history of DM, know DM can cause periodontal disease, know DM can cause dental caries, knows about tooth filling, know about tooth replacement and history of tooth replacement. All the participants were then educated once on how to maintain good oral hygiene by given then oral hygiene instructions, though reminders were given on follow up visits. They were also educated on the

importance of tooth filling and effect of DM on standing teeth and its supporting structures. Dental and periodontal status of the teeth of each participant was then evaluated at the end of 2wks, 4wks, 6wks and 8wks. Data collection was done by a single examiner to reduce inter-examine.

Data analysis

Statistical analysis was done using Statistical Package for Social Science (SPSS) version 21 for windows. Categorical data were summarized as frequencies and percentages while quantitative data were summarized as mean and standard deviation. ANOVA test was used in determining if there was a statistically significant difference in gingival bleeding, peri-odontal scores and other parameters pre and post oral health instructions sessions (at 2,4,8 and 8, weeks). Level of statistical significance was set at $P < 0.05$.

Results

A total of 96 participants who met the inclusion criteria participated in this study. Majority were female 63(66.0%) while the most common age group was 55 to 64(42.7%). Furthermore, 33(34.4%) attained tertiary level of education and the occupational group distribution shows that almost half 47(49.0%) were involved in private business. Most of the participants 23(24.0%) had

DM for 8-9years while those with family history of DM (75.0%) were more than those without family history of DM. (Table 1)

Only 38(40.0%) of the study participants knew that DM can cause periodontal disease, 33(40.0%) knew DM can cause dental caries, 40(42.0%) knew about tooth filling, 40(42.0%) knew about tooth replacement and 36(37.0%) have had tooth replacement. (Table 2)

Table 2: Knowledge regarding diabetes mellitus causing periodontal disease, dental caries, knowledge of tooth restoration and history of tooth replacement among study participant

Variable	Frequency(n=96)	Percentage (%)
Knows DM cause periodontal disease		
Yes	38	40.0
No	58	60.0
Knows DM cause Dental caries		
Yes	33	33.0
No	63	67.0
Knows about tooth filling		
Yes	40	42.0
No	56	58.0
Knows about tooth replacement		
Yes	40	42.0
No	56	58.0
History of tooth replacement		
Present	36	37.5
Absent	60	62.5
Knowledge of tooth Restoration		
GIC	32	33.3
Composite	22	23.1
Amalgam	15	15.4
Denture	15	15.4
Dental Bridge	12	12.8

Table 1: Sociodemographic characteristics of study participants

Variable	Frequency(n=96)	Percentage (%)
Sex		
Male	33	34.0
Female	63	66.0
Age group/years		
45-54	18	18.8
55-64	41	42.7
≥65	37	38.5
Highest level of education		
Nil formal education	24	25.0
Primary	14	14.6
Secondary	25	26.0
Tertiary	33	34.4
Occupation		
Brick laying	2	2.0
Farming	12	12.5
Business	47	49.0
Civil servant	16	16.7
Pensioner	7	7.3
No response	12	12.5
Duration of DM/years		
1-3	20	20.8
4-6	15	15.6
8-9	23	24.0
14-15	19	19.8
18	19	19.8
Family history of DM		
Yes	72	75.0
No	12	12.5
Don't know	12	12.5

The mean gingival bleeding index was highest at baseline, then steadily decreased at post oral health education intervals from 2 weeks and became 0 at 8 weeks. The mean values were statistically significant ($P=0.000$). (Table 3)

Table 3: Comparison of mean of gingival bleeding scores between pre-oral health education (baseline) and at post oral health education intervals using gingival bleeding index

Period	N	Mean	Std. Deviation	ANOVA	P-value
Baseline (before oral health education)	96	25.28	9.875	81.901	<0.001*
Post oral health education interval:					
2 weeks	96	14.43	3.184		
4 weeks	96	4.43	0.925		
6 weeks	96	0.68	0.054		
8 weeks	96	0.0	0.0		

Post hoc test of in-between group comparison shown that the mean differences between groups

were all significantly remarkably reduced at weeks 2, 4, 6 and 8 weeks compared with baseline before oral health education. (Table 4)

Table 4: Post hoc test for in-between group comparison of mean difference between intervals of gingival bleeding scores

	Baseline	2 weeks	4 weeks	6 weeks	8 weeks
Baseline	1	10.852*	20.852*	24.602*	25.284*
2 weeks		1	10.000*	13.750*	14.432*
4 weeks			1	3.750	4.432
6 weeks				1	0.682
8 weeks					1

*=statistically significant mean difference at $P < 0.05$

The mean periodontal disease index was highest at baseline, then steadily decreased at post oral health education intervals from 2 weeks to 4 weeks, slightly spiked at 6 weeks, then remarkably dropped at 8 weeks. The mean values were statistically significant ($P = 0.000$). (Table 5)

Table 5: Comparison of mean periodontal scores between pre-oral health education (baseline) and at post oral health education intervals using periodontal disease index

Period	N	Mean	Std. Deviation	ANOVA	P-value
Baseline (before oral health education)	88	0.68	0.078	13.082	0.000*
Post oral health education:					
2 weeks	88	0.56	0.056		
4 weeks	88	0.23	0.097		
6 weeks	88	0.24	0.003		
8 weeks	88	0.02	0.00		

The post hoc test of in-between group comparison presented in Table 6 shows that the mean difference between baseline and week 2 were not significantly different. However, that at weeks 4, 6 and 8 were all significantly low in comparison with that found before oral health education.

Table 6: Post hoc test for in-between group comparison of mean difference at intervals of periodontal disease index scores

	Baseline	2 weeks	4 weeks	6 weeks	8 weeks
Baseline	1	0.125	0.455*	0.443*	0.659*
2 weeks		1	0.330*	0.318*	0.534*
4 weeks			1	0.011	0.205
6 weeks				1	0.216
8 weeks					1

*=statistically significant mean difference at $P < 0.05$

Knowledge of GIC was most common among study participants (33.3%). Table 2. The prevalence of dental caries was 77.7%, that of missing teeth was 58.0% while that of periodontal disease was 31.8% (Figure 1)

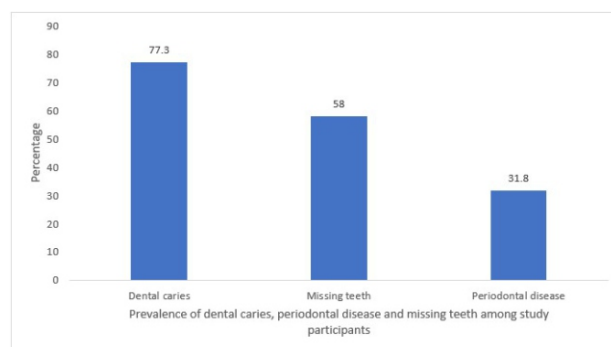


FIG 1: Prevalence of dental caries, missing teeth and periodontal disease among diabetic patients pre intervention

Dental caries among study participants progressively decreased from a mean value of 2.27 before health education to 0.23 8 weeks after education. Filling, on the other hand conversely increased from 0.60 at baseline steadily becoming 2.39 at 8 weeks after health education. Missing teeth had a mean of 1.48 at baseline, slightly increased and became 1.61 at 8 weeks after health education. (Figure 2).

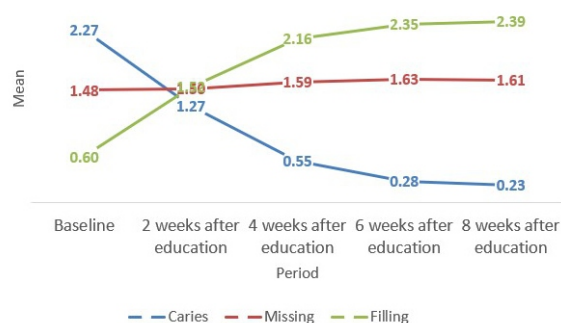


FIG 2: Line graph showing dental caries, missing and filling of tooth at 2, 4, 6 and 8 weeks after oral health education in comparison with baseline (before education).

Discussion

Diabetes mellitus is a chronic disease which affects various organs of the body including the standing teeth and its supporting structures. The knowledge

of the effect of DM is very important as this help those suffering from this disease condition to better manage it and limit its complications on various organs of the body including the mouth.^{2,3}

Majority of the study participants which are age fifty-five years and above is in agreement with another studies that showed that DM and its oral complications is common within this age.^{15,16} The effect of DM on various organs of the body is more at this age were most of the patients develop oral complications. This may be the reason while sufferers of DM at this age present more in the dental office requesting for restoration of carious tooth or replacement of missing teeth.^{1,8}

Female participants were more than the males in this study. This is different from another study where the males were more.¹⁶ This may be associated with more hormone in females, less physical activity, more fat deposits and lower socioeconomic status which has be showed to predispose females to developing DM.^{15,16,17}

Most of the study participants had tertiary level of education which should have contributed to their knowledge of DM and its complications, unfortunately this was not the case, as most of the participants were not aware that DM can cause oral disease. Majority were involved in private business. This may not be unconnected with lack of white-collar job which has necessitated the need for people to go into private business.

Diabetic condition of over ten years were more in numbers. DM is a chronic disease that does not have a permanent cure. The use of drugs and lifestyle modification has been proven to be effective in its management. More so, the knowledge of its effect on the organs of the body also helps the sufferer to adhere to proper management protocol and follow up with medical appointment. Those with family history of DM account for higher proportion among study participants. This agrees with other studies that DM has a family history and that those with family history of DM has higher chances of having DM than those without family history.^{3,6}

Poor knowledge that DM can predispose to dental caries was high among the study participants. This may have resulted in high prevalence of dental caries in this study. Dental caries which can result in tooth loss has been reported to be high among DM patients, as studies^{10,18} have showed that DM patients

often present in the dental office for one form of tooth restoration or replacement. Furthermore, most were not also aware that carious tooth can be filled with restorative materials such as Composite, GIC etc while missing tooth/teeth can be replaced with removable partial denture or fixed partial denture. This was demonstrated in many of them not having visit the dental office for the above treatment. The knowledge of GIC and Composite were more as tooth restorative material. These materials have recently been preferred in the restoration of carious teeth. They have the advantages of aesthetic and preservation of tooth material, hence less destruction of the remaining tooth substance.¹⁹ This material also has the added advantage of remineralizing carious tooth which further help the affected tooth to become resistance to further caries formation.

The prevalence of Dental Caries in this study was high. This corroborates other studies.^{16,18} DC is one of the oral complications of diabetic mellitus and this is even worse in patients with poor oral hygiene which may have been the case in this study.^{8,9} This finding is different from another study¹⁶ that showed that there was no significant difference in the prevalence of dental caries in diabetic and non-diabetic, though the number of missing teeth in diabetes was more than non-diabetic which the researcher concluded may have affected the outcome. It is therefore important that the diabetes know that the disease condition can predispose to dental caries and that maintaining good oral hygiene help to reduce the incidence of dental caries.

Post oral health education, there was an increased in the mean value of filled teeth and a decreased in the mean value of carious teeth. This inferred that there was a positive respond to the oral health education that they received as reflected in the decline of carious teeth and increased in filled teeth two to eight weeks post oral health education. A decreased in the carious teeth and increased in filled teeth post oral health education showed a positive respond to oral health education of any group of people or community.²⁰ There is dearth of literature concerning this topic, but this study has proved that oral health education can help improve on the oral health of the diabetes by reducing the prevalence of dental caries thereby improving on the quality of life of those affected.

There was a slight increase in the number of missing teeth from baseline to eight weeks post oral health education. This increased in tooth loss could be from dental caries and or periodontal disease because the participants could not maintain good oral hygiene, or were not motivate to restore their carious tooth or were unable to afford dental treatment. These could also be the reasons for the high prevalence of missing teeth at baseline. High prevalence of missing teeth in this study is in agreement with another study that compared DM with Non-DM patients and find out that dental caries and periodontal disease were more in DM patients as these two conditions result in multiple tooth loss in DM.²¹ It is therefore imperative to educate DM patients that maintaining good oral hygiene, early restoration of carious tooth can help reduce prevalence of DC and early tooth loss.

The prevalence of periodontal disease at baseline among the study participants was high, though there was a steady decline in the mean value of gingival bleeding index and periodontal disease index two to eight weeks post oral health education and the difference in the mean value was significant. This decline was also showed in post hoc test. Decline in the values of these indices may not be unconnected with the maintenance of good oral health post oral health education which the participants received after baseline examination, as maintaining good oral health in diabetes has be proven to reduce the effect of DM in the oral cavity including the standing teeth and its supporting structure.^{1,2,3} Periodontal disease is one of the commonest oral complications of DM especially among those who do not maintain good oral hygiene.^{1,6} This condition can result in multiple tooth loss and if not properly manage result in complete edentulism,^{22,23} but maintaining good oral hygiene after proper oral health education as reflected in this study, the effect of DM on the periodontium of the standing teeth can be greatly minimized and these help to prolong the life span of the standing teeth thereby reducing the prevalence of tooth loss among diabetes.

Conclusion: The prevalence of dental caries and periodontal disease among DM can be reduced with proper oral health education thereby improving the quality of life of the patients.

Recommendations:

1. Oral health education should be incorporated as part of management modalities for DM patient
2. Management of dental caries and periodontal disease should be subsidized for DM patients in all government hospital. This will help DM patients to present themselves early for treatment of DC and periodontal disease
3. Dentist should be included as part of management team for DM patients
4. Doctors should be train on how to diagnose DC and periodontal disease as they may be the first point of contact by DM patient. This will help them to properly refer such patient to the dentist.

Limitation of the Study: Participants of this study should have been compared with another group that did not receive oral health education which was not done. This may have further showed the importance of oral health education among DM patients.

Conflict of interest: none

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