

**A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF ÇANKIRI KARATEKİN UNIVERSITY**

THE EFFECT OF DIABETES ON THE MOUTH AND GUMS



**IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
CHEMISTRY**

BY

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ÇANKIRI

2022

THE EFFECT OF DIABETES ON THE MOUTH AND GUMS

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November 2022

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ABSTRACT

THE EFFECT OF DIABETES ON THE MOUTH AND GUMS

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Master of Science in Chemistry

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November 2022

Diabetes is frequently associated with oral issues such as gingivitis, gum disease, mouth sores, gum caries, searing mouth syndrome, periodontal abscesses, infections, and impaired taste perception. 50 hospitalized patients at Misrata Medical Center Hospital with diabetes and 50 individuals without diabetes made up the research sample. Before an interview, a clinical assessment of the each participant's oral health state was made and recorded. In comparison to non-diabetics, diabetic patients had gums indices that were more over 1/3 and below or equal to 2/3. The plaque index and diabetes status had a statistically significant relationship. Diabetic patients also had mild gingivitis, color is slightly different AND swollen, and are more prone to tooth ache and dryness. There is a sizable information gap about the connection between diabetes and periodontal diseases, and there is a lack of understanding regarding the necessity of coordinated management by medical and dental specialists. The diabetes group had a lot higher oral pathology than the non-diabetic group. Smokers with diabetes are more likely than non-smokers to get serious gum disease. For the optimum treatment of diabetic patients, more work should be invested into advancing understanding and putting it into action.

2022, 39 pages

Keywords: Mobility index, Plaque, Diabetics, Non-diabetics, Gingiva

ÖZET

DIYABETİN AĞIZ VE DİŞ ETLERİ ÜZERİNE ETKİSİ

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Kasım 2022

Diş eti iltihabı, periodontal hastalık, ağız kuruluğu, oral kandidiyazis, diş çürükleri, periapikal apseler, yanan ağız sendromu ve bozulmuş tat algısı sıklıkla diyabetle bağlantılı ağız sorunları arasındadır. Araştırma örneklemini Misrata Tıp Merkezi Hastanesi'nde yatan diyabetli 50 hasta ve diyabetsiz 50 birey oluşturmuştur. Her hastanın ağız sağlığı durumu görüşme öncesi klinik olarak değerlendirildi ve kaydedildi. Diyabetik hastaların diş eti indeksi diyabetik olmayanlara göre 1/3'ten büyük ve 2/3'e eşit veya daha azdı. Plak indeksi ve diyabet durumu istatistiksel olarak anlamlı bir ilişkiye sahipti. Diyabetik hastalarda hafif diş eti iltihabı da vardı, rengi biraz farklı ve şişti ve diş ağrısına ve kuruluğuna daha yatkındır. Diyabet ve periodontal hastalıklar arasındaki ilişki hakkında bir rapor, önemli bir bilgi boşluğunun yanı sıra ihtiyacın takdir edilmediğini ortaya koydu. Tıp ve diş hekimliği uzmanları tarafından işbirlikçi yönetim için. Diyabetik olmayan grupla karşılaştırıldığında, diyabetli grupta önemli ölçüde daha fazla oral patoloji vardı. Sigara içenlerin diyabetli sigara içmeyenlere göre ciddi diş eti hastalığına yakalanma olasılığı daha yüksektir. Diyabet hastalarının en iyi bakımı için bilgiyi geliştirmek ve uygulamaya koymak için daha fazla çaba harcanmalıdır.

2022, 39 sayfa

Anahtar Kelimeler: Hareketlilik indeksi, Plak, Diyabetikler, Diyabetik olmayanlar, Dişeti

PREFACE AND ACKNOWLEDGEMENTS

I would like to thank my thesis advisor, Prof. Dr. Volkan EYÜPOĞLU, for his patience, guidance and understanding. First and probably most important, I want to thank Almighty Allah for helping me do the project that was given to me by my supervisor. Despite several challenges that developed during my thesis studies, I was able to complete my thesis with the help of my friends with whom I collaborated. During this time, I'd want to express my gratitude to my teacher, Assoc. Prof. Dr. Şevki ADEM, because without his guidance, my thesis would not have been completed successfully. I'm grateful to him for her guidance and assistance during my studies, which enabled me to get positive results from my research. Last but not least, I would want to thank my close family and friends for always supporting my efforts to do good things. I'm hoping that all of our hard work will pay off for me and our other collaborators.

Sukina Abdallah Alshaybani SHAABAN

Çankırı-2022

CONTENTS

ABSTRACT	i
ÖZET	ii
PREFACE AND ACKNOWLEDGEMENTS	iii
CONTENTS	iv
LIST OF SYMBOLS	vi
LIST OF ABBREVIATIONS	vii
LIST OF FIGURES	viii
LIST OF TABLES	ix
1. INTRODUCTION	1
1.1 Diabetes Mellitus	1
1.2 Aim of Study	2
2. LITERATURE REVIEW	3
2.1 The Oral Cavity and Diabetes	3
2.1.1 Xerostomia	3
2.1.2 Burning mouth sensation	4
2.1.3 Periodontitis	6
2.1.4 Mechanism of action	8
2.1.5 Dental caries	9
2.1.6 Acute oral infections	10
2.1.7 Salivary dysfunction	10
2.1.8 Altered taste sensation	11
3. MATERIALS AND METHODS	13
3.1 Materials	13
3.1.1 Study population	13
3.1.2 Criteria for inclusion	13
3.1.3 Criteria for exclusion	14
3.1.4 Selection of study participants	14
3.1.5 Sample size estimation	14
3.1.6 Piloting the questionnaire	14
3.1.7 Data collection	15

3.2 Methods of Mouth Examination	16
3.2.1 Plaque index (PI)	16
3.2.2 Criteria and codes	16
3.2.3 Gum index (GI)	16
3.2.4 Mobility index (MI)	17
3.3 Data Analysis	17
4. RESULTS AND DISCUSSION	18
4.1 Demographic Information	18
4.2 Oral Health Status	19
4.2.1 Plaque index	19
4.2.2 Gums index	19
4.2.3 Mobility index	21
4.3 Oral Pathology	21
4.3.1 Practices in general health and oral hygiene	23
5. CONCLUSIONS AND RECOMMENDATIONS	26
5.1 Conclusions	26
5.2 Recommendations	31
REFERENCES	33
CURRICULUM VITAE	39

LIST OF SYMBOLS

-	Minus
%	Percent
**	Significant
/	Divide
+	Plus
<	Greater than
=	Equal
>	Less than
±	Plus – minus
≤	Greater or equal to
≥	Less or equal to
Ca	Calcium
Cu	Copper
dL	Deciliter
g	Gram
kg	Kilogram
L	Liter
m ²	Square meter
mcg	Microgram
Mg	Magnesium
mg	Microgram
mIU	Milli-international units
min	Minute
mL	Milliliter
mmol	Milli mole
mol	Mole
ng	Nanogram
nm	Nanometer
NS	Non-significant
rpm	Revolutions per minute
Se	Selenium
Zn	Zinc
μL	Micro liter

LIST OF ABBREVIATIONS

AGEs	Advanced glycation end products
DM	Diabetes mellitus
GI	Gum index
HbA1	Hemoglobin subunit alpha 1
HBA1c	Hemoglobin A1c
IDDM	Insulin dependent diabetes mellitus
MI	Mobility index
NADPH	Nicotinamide adenine dinucleotide phosphate
NHS	National health service
NIDDM	Non insulin dependent diabetes mellitus
PI	Plaque index
PMNs	Polymorphonuclear leukocytes
T1DM	Type 1 diabetes mellitus
T2DM	Type 2 diabetes mellitus

LIST OF FIGURES

Figure 4.1 The emergence of gingiva index in DM and non-diabetic individuals 20



LIST OF TABLES

Table 4.1 Demographic data based on the presence or absence of diabetes..... 18
Table 4.2 Plaque index by diabetic disease status..... 19
Table 4.3 Gums index by diabetic disease status 20
Table 4.4 Mobility index by diabetic disease status 21
Table 4.5 Comparison of oral pathology by diabetic disease status 22
Table 4.6 Practices in general health and oral hygiene 24
Table 4.7 Participants' health awareness and behavior 25



1. INTRODUCTION

1.1 Diabetes Mellitus

A variety of metabolic diseases known as diabetes mellitus are distinguished by insulin resistance, insulin insufficiency, or either (Daneman 2006). The inability of the body's homeostatic processes to maintain regular blood sugar levels in all sufferers results in hyperglycemia. Despite having been recognized for thousands of years, diabetes was a deadly illness before the advent of insulin therapy (Banting *et al.* 1922).

Today, most kinds of diabetes mellitus may be managed with insulin or anti-diabetic drugs, although chronic issues are still frequent. Diabetes mellitus is the major cause of mortality in the world, accounting for one in every eight fatalities (12.2 %) among those aged 20 to 79 in 2010 (Vernillo 2003). Average life expectancy is decreased by far more over 20 years by type 1 diabetes, and by up to a decade by type 2 diabetes (Diabetes 2011).

According on aetiopathogenesis, diabetes mellitus is categorized into four distinct categories, with two primary kinds of diabetes accounting for the great majority of cases. 99.4% of cases of diabetes in Scotland are due to type 1 diabetes mellitus (T1DM), formerly defined as insulin dependent diabetes mellitus (IDDM), and type 2 diabetes mellitus, formerly referred to as non-insulin based diabetic mellitus (NIDDM). They are the majority prevalent throughout the entire world (Atlas 200).

Various classifications include diabetes during pregnancy as well as other kinds of diabetes. These latter conditions include exocrine pancreas diseases, endocrinopathies, and diabetes brought on by drugs, chemicals, or infectious agents, as well as those related to gene abnormalities in pancreatic β cell growth and insulin resistance, various diabetes syndromes, and exocrine pancreas illnesses (Sreebny *et al.* 2010).

The above taxonomy has been modified to reflect the aetiopathogenesis of the groupings instead of their therapeutic implications. It also acknowledges that different therapy approaches and presentations may change over time, suggesting that patients shouldn't be categorized solely on these shared traits. Due to the confusion they caused when they were used, the terms insulin-dependent diabetes mellitus and non-insulin-dependent diabetes mellitus, together with their acronyms IDDM and NIDDM, were eliminated from the classification. Arabic numerals were substituted for the English "type 1 diabetes mellitus" and "type 2 diabetes mellitus" (Nada *et al.* 2020).

One of most prevalent form of diabetes, type 2 diabetes mellitus, is brought on by insulin resistance, which may or may not be accompanied by aberrant secretory function. It is often associated with growing older and is tied to environmental and genetic risk factors. Type 2 diabetes, which is a component of the metabolic syndrome, which also includes hypertension, dyslipidaemia, and hyperglycemia, is typically preceded by a protracted period of poor glycemic control. Type 2 diabetes has a higher inherited aetiology than T1DM, despite environmental factors including diet, activity, obesity, and smoking having an influence on its development (Stumvoll *et al.* 2005).

1.2 Aim of Study

To determine the impact of uncontrolled diabetes on periodontal tissue health. To make diabetics aware of the significance of seeing the dentist and getting a regular periodontal checkup, as well as maintaining good oral hygiene.

2. LITERATURE REVIEW

2.1 The Oral Cavity and Diabetes

The oral mucosa undergoes the same alterations as the kidney, nerves, and retina. Diabetes-related oral health issues include xerostomia, tooth loss, gum disease, periodontal, ectodermal abscess, infections, and tendon diseases of the tongue and mucosa (Vernillo 2003, Moore *et al.* 1999, Moore *et al.* 1998).

Patients with diabetes typically have the burning mouth syndrome, have slower wound healing, and have more acute oral infections. Compared to Type 2 patients, Type 1 uncontrolled DM patients exhibit and have greater oral issues.(Vernillo 2003).

2.1.1 Xerostomia

Diabetes patients often have the oral condition known as xerostomia, which is brought on by a reduction in fluid intake (Murrah 1985). About one five adults experience xerostomia (Thomson *et al.* 2006). It is linked to polyuria, which diabetes people frequently encounter. Both diabetes and the drugs was using to treat it may contribute to xerostomia. The parotid glands can sometimes enlarge in conjunction with xerostomia (Mealey and Oates 2006).

The normal oral mucosal environment is affected by autonomic nervous system neurotoxicity, which is hypothesized to change salivary production and predispose a healthy mouth to dental caries. (Vernillo 2003).

Sore throat may make oral tissues more vulnerable to strain and viral diseases like Candida in addition to increasing the building of bacterial plaque and food debris, which causes dental caries and gum disease (Rees 2000).

Xerostomia may well be linked to problems with eating, swallowing, taste, speaking, and hearing, which can lead to insufficient nutrient intake, malnutrition, and social problems (Soell *et al.* 2007). It has lately been shown to have an effect on the quality of life connected to dental health (Thomson *et al.* 2006).

In a research conducted by Sreebny and his team in 2010, xerostomia in diabetics was examined. Forty adult diabetes volunteers of both sexes and ages participated in the study, along with a control group of equally sized and grained healthy non-diabetic adults. Participants in the research were not allowed if they were taking xerogenic medicines or suffered from any other major illnesses.

All patients completed a questionnaire, and the laboratory steps were run on them: the relaxation and stimulation of entire saliva flow rates, the Schirmer's test (lacrimal fluid), the expiration-inspiration ratio, the 30:15 ratio, the Valsalva ratio, serum glucose, and HbA1c levels (Nada *et al.* 2020).

According to their findings, ambulatory diabetes people frequently experience the sensation of sore throat. It has a strong correlation with measures of reduced salivation as well as other mouth and extraoral symptoms of desiccation. Oral dryness may be caused by problems with glycemc management rather than cardiovascular autonomic system malfunction (Sreebny *et al.* 2010).

2.1.2 Burning mouth sensation

Although the exact etiology of this condition is unknown, it has been connected to neurological problems including depression, candidiasis, and malfunction of the salivary glands (Vernillo 2003). Patients who complain of a burning mouth feel no visible lesions other than discomfort and a burning tongue sensation. While there is no concrete evidence to support it, it is also hypothesized that this state is common in people with acute diabetes mellitus when neuropathic pain is a complication (Rees 2000).

The term "gingivitis" refers to a situation in which the inflammatory gingival tissues around a tooth are not currently losing their connection to the tooth or their bone (Tan *et al.* 2006).

The most common and mild type of periodontal disease is characterized by frequent bleeding, erythema, and swelling of the gums (Kim and Amar 2006). This bacterial plaque-induced gingival irritation can be reversed if therapy is started at an early enough stage (Soell *et al.* 2007).

The circulatory alterations in a diabetic patient's mouth likely make this bleeding worse since inflammation might appear as gingival bleeding (Orbak *et al.* 2008). There is a connection among gingiva and plaque and calculus buildup, which serve as local irritants to the gingiva and promote gum inflammation, in addition to the microvascular changes that lead to gingival bleeding (Orbak *et al.* 2008). High salivary glucose may potentially contribute to inflammation by promoting the growth of bacteria and plaque. (Vernillo 2003).

The incidence of burning mouth syndrome was examined by Nada and her colleagues (2020) in a sample of Egyptian diabetic neuropathy patients. This study set out to find out how common burning mouth syndrome was among type 2 diabetics who also had peripheral neuropathy. The research included 250 people with type 2 diabetes mellitus who had been clinically determined to have peripheral neuropathy. A clinical examination was performed to rule out any oral lesions (Nada *et al.* 2020).

The dichotomous method was used to record oral symptoms of burning mouth syndrome, such as xerostomia, impaired taste perception, and burning sensation. Their research showed a positive correlation between local variables and metabolic regulation as well as a beneficial association between local factors and burning mouth syndrome. Burning mouth syndrome in diabetic neuropathy patients is difficult. The oral variables that contribute to poor metabolic regulation. To prevent the consequences of hyperglycemia on the oral mucosa and subsequent worsening in the neuropathic mechanism, good metabolic management is necessary (Nada *et al.* 2020).

2.1.3 Periodontitis

Gum disease is a disorder that affects the tissues supplying the teeth and is characterized by inflammation. It is brought on by specific microorganisms or groups of specific germs and causes pockets to form or deepen in the periodontal tissues and alveolar (Tan *et al.* 2006). According to current statistics, this disorder ranks below retinal, nephritis, neurotoxicity, peripheral vessel disease, and cardiovascular events as the sixth most prevalent consequence of diabetes (Kidambi and Patel 2008, Almas *et al.* 2003, Vernillo 2003, Zielinski *et al.* 2002).

It is sometimes alluded to as diabetes' sixth "opathy" (Mansour and Abd-Al-sada 2005). The cause of periodontitis is gram-negative anaerobes present in the subgingival plaque. The bacteria most frequently linked to periodontitis include Porphyromonas gingivalis, Prevotella intermedia, Tannerella forsythensis, and Treponema denticola (Soell *et al.* 2007).

This illness is characterized by oxidative stress, which is a substantial contributor to diabetic vascular issues (Karima *et al.* 2005). Diabetes patients' heightened inflammatory reaction to the periodontal microflora is assumed to be the cause of periodontitis (Lamster *et al.* 2008).

As an outcome, collagenous connections are lost, and alveolar bone height decreases, resulting in a chronic inflammatory disease (Almas *et al.* 2003). The likelihood of developing periodontitis and its severity depend on whether a patient has diabetes mellitus and how effectively they are able to control their condition (Tan *et al.* 2006, Mealey 2008, Rees 2000).

According to epidemiologic research and case reports, a substantial risk factor for periodontal disease is diabetes even though it has an effect on diabetic management (Wilder *et al.* 2009, Tan *et al.* 2006, Karima *et al.* 2005, Tan *et al.* 2006).

This demonstrates how diabetes and periodontitis are related. There is evidence that gum disease may raise the chance of having dysfunctional metabolic control (Lamster et al. 2008) or that patients with diabetes mellitus may experience worse glycemic control if they have periodontal disease. (Herring and Shah 2006).

One frequent side effect of diabetes is periodontitis, which becomes worse as the condition gets worse (Moore *et al.* 1999). One meta-analysis of Eighteen related cross-sectional studies found that people with mellitus had much more severe periodontal disease than did healthy individuals (Wilder *et al.* 2009). Without a doubt, diabetes lowers the immune system's defenses, making diabetic individuals both more prone to infections and more likely to have severe symptoms of such diseases than non-diabetic patients (Bjelland *et al.* 2002).

It is believed that periodontitis as a diabetic complication develops as a result of a heightened inflammatory process to periodontal bacteria (Lamster *et al.* 2008). This idea is somewhat supported by data demonstrating no variations in gingiva micro flora between those with periodontitis and their non-diabetic counterparts (Campus et al. 2005).

The etiology of diabetes has been connected to elements that exacerbate the severity of inflammatory illness, such as neutrophil dysfunction. In diabetics, microbial plaque and pre-existing hyperglycemia are the main causes of periodontal disease (Wilder *et al.* 2009). Advanced glycation end products (AGEs), which are produced when proteins like collagen are glycosylated in a hyperglycemic environment, are critical in the degradation of periodontal tissue (Tan *et al.* 2006).

As a result, the patient's periodontal health deteriorates, resulting in deep pockets and tooth movement, which commonly necessitates tooth extraction. After extraction, people's quality of life declines because they are unable to chew their food, It results in bad eating habits, the consumption of more processed carbohydrates and less fiber foods (Soell *et al.* 2007).

According to Moore *et al.* (1999), inability to maintain a balanced diet and proper glycemic control due to periodontal disease and tooth loss may have an effect on general health.

Diabetes mellitus and periodontal diseases were investigated by (Mealey and Oates 2006). The stated goal of this article is to provide details on the connection between diabetes and periodontal diseases. With a few "classic" papers from before that time, this page provides a thorough account of the most significant discoveries from research that has been published in English over the past 20 years. Their research addresses existing diabetes categorization and diagnostic criteria and responds to the following queries: 1) Is diabetes a risk factor for periodontitis, and does the degree of metabolic control in diabetes affect this relationship (Bender and Bender 2003).

There are multiple biologically valid factors for why diabetes increases the risk of periodontal disease. The effects of periodontal conditions on diabetes glycemic management and the mechanisms by which this occurs are less obvious. Similar to how fat increases insulin resistance, inflammatory periodontal disorders can exacerbate glycemic control. To completely comprehend this aspect of the connection between periodontal diseases and diabetes, more study is required. (Boyle and Shone 2006).

2.1.4 Mechanism of action

Patients with diabetes may be more susceptible to periodontitis due to additional pathophysiologic changes as reduced leukocyte chemotaxis, phagocytosis, apoptosis, serum opsonic activity, and impaired cellular immunity. Even after receiving conventional periodontal treatment, a diabetic patient's periodontal infection may not be totally eradicated because of diabetes's decreased immune response. (Tan *et al.* 2006).

Superoxide and hydrogen peroxide, both of which are naturally present in neutrophils, are stimulated to be produced in large quantities by neutrophils during the inflammatory

process. NADPH, an oxidative complex that facilitates this process, causes an increase in oxidative stress, which has been associated with periodontitis (Karima *et al.* 2005).

Similar to the cytokines released by visceral belly fat tissue, inflamed periodontal tissue also generates them. These cytokines, which include interleukin 6 (IL6) and tissue necrosis factor-alpha (TNF), have the potential to make diabetes worse (Skamagas *et al.* 2008). Age, smoking, and the activity of neutrophil elastase in gingival crevicular fluid have all been identified as risk factors for diabetic periodontal disease (Tan *et al.* 2006).

Enzyme β -glucuronidase, a lysosomal enzyme, is also released when PMNs degranulate during the inflammatory process (Tan *et al.* 2006). Activating metalloproteinase, which breaks down the collagen in the ligaments, is another theory that links the production of reactive oxygen species to the loss of tooth attachment (Herring and Shah 2006).

2.1.5 Dental caries

Diabetes mellitus and dental caries don't appear to be related, and published data is occasionally conflicting (Soell *et al.* 2007). Perhaps the reason for this discrepancy is because diabetes patients exhibit a variety of behavioral patterns, with those who are cooperative and motivated practicing excellent oral hygiene and going to the dentist frequently as opposed to those who are not (Zielinski *et al.* 2002).

A less cariogenic diet may lessen the incidence of caries since most diabetics restrict their consumption of fermentable carbohydrates (Mealey and Oates 2006). In both human and animal investigations, it has been discovered that people with poorly managed or unmanaged diabetes mellitus have a higher prevalence of dental caries (Rees 2000).

Miko looked on the connection between adolescent diabetes type 1 and dental cavities. This study's objective was to assess the incidence of dental caries in young people with type 1 diabetes (DM). 259 adolescents with type 1 diabetes had a clinical evaluation, and

they were contrasted with 259 metabolically healthy controls who were age- and gender-matched. The DM patients were categorized using postprandial blood glucose and HBA1c levels, illness duration, age at start, and level of control. To evaluate dental caries, the DMFT index was applied. Shapiro-W, Wilk's Analysis, Student t, and Tukey's posthoc test were used to examine the data (Dotson *et al.* 2008).

None of the DM patients had a full dentition, according to their results. In comparison to controls, DM adolescents had significantly more filled teeth ($p=0.001$), fewer decayed teeth ($p=0.0001$), and a higher mean DMFT score ($p=0.001$). When compared to patients with worse glycemic control, adolescents with well-controlled DM had a lower mean number of decaying (D) teeth and more filled (F) teeth (Wilder *et al.* 2009).

If dental hygiene was good, early diabetes onset was linked to fewer filled and decayed teeth ($p = 0.0001$). As a result, while poor glycemic control and an early onset of DM may increase the risk of dental caries, good oral hygiene practices together with sufficient metabolic control may help adolescents with type 1 DM avoid developing dental caries (Miko *et al.* 2010).

2.1.6 Acute oral infections

This is in reference to diabetics with poorly controlled blood sugar levels who have persistent virus of herpes simplex infections, gingival abscesses, and palate ulcers. These infections are believed to be brought on by the same pathogenic mechanism that raises the risk of periodontal diseases (Vernillo 2003).

2.1.7 Salivary dysfunction

Since factors including medication, age, neuropathy, and thirst can all contribute to reduced salivary flow, diagnosing this ailment can be challenging. Nevertheless, diabetics frequently experience this. It is associated with xerostomia, which can result in mucosal dryness and help to promote tooth caries. Mucositis, ulcers, and desquamation

are commonly present along with it, and the tongue is frequently inflamed and depapillated (Vernillo 2003).

This looked into the effect of insulin resistance (types I and II) on the functioning of the human salivary gland to that of age-matched healthy controls. The findings demonstrated that type I and type II diabetes patients released considerably less saliva both at rest and when prompted compared to healthy, age-matched controls (AMC). Additionally, it was found that diabetes patients have greater salivary protein concentrations while stimulated and at rest compared to healthy participants (Dotson *et al.* 2008).

The secretory capacity (stimulated minus resting levels) was considerably lower compared to controls. Saliva from diabetes patients had much more Calcium (Ca^{2+}) than did the AMC. In contrast, diabetes patients' saliva had considerably lower amounts of magnesium (Mg^{2+}), zinc (Zn^{2+}), and potassium (K^+) than did AMC. These findings suggest that diabetes mellitus can cause significant impairment of the salivary glands' secretory capability. These people may be more prone to oral infections and have slower wound healing because of altered fluid, organic, and inorganic salivary production (Mata *et al.* 2004).

2.1.8 Altered taste sensation

The development of diabetic neuropathy or changed glucose receptors have both been connected to the change in taste (Bender and Bender 2003). Taste has a substantial influence on food desire and intake, and changes in taste perception have been linked to taste receptor polymorphisms (Dotson *et al.* 2008). Xerostomia and candidiasis have also been connected to it (Boyce and Shone 2006), either as a direct result of diabetic neuropathy or as a side effect of therapy. When compared to other taste tests, sugar may cause a more severe reduction in taste sensitivity, which might be a direct result of diabetes mellitus (Rees 2000).

There is evidence of TAS1R and TAS2R taste receptors, which are responsible for the perception of bitter and sweet tastes, respectively (Dotson *et al.* 2008). It's a common belief that aging leads to changed taste perceptions. According to one idea, taste loss develops naturally with age as a result of alterations to taste cell membranes that affect ion channel and receptor activation (Boyle and Shone 2006). Diabetic patients receiving hemodialysis have reported experiencing this problem (Lamster *et al.* 2008).



3. MATERIALS AND METHODS

3.1 Materials

In this chapter, the research design and methodology are covered. Collection of data, population being studied selection, location of the research, study design, random sample estimation, data processing, and ethical considerations are all discussed. It also explains the research instrument and data gathering techniques. The study was conducted at at Misrata Medical Center Hospital in Libya from July to September 2021 using an analytic cross-sectional survey approach.

3.1.1 Study population

The research population consists of all diabetic and non-diabetic patients with ages of 25 and 75 who visited PMMH during July and September 2021. The decision to employ a three-month data collecting period was made so that the researcher would have more time to gather data. The diabetic individuals for this study were patients at the Misrata Medical Center Hospital diabetes clinic.

Patients who visited the same hospital's outpatient department for other reasons and had a documented medical history indicating they did not have diabetes made up the non-diabetic group. The age range of 25 to 75 years was chosen since it was thought that it would be acceptable for both Type 1 and Type 2 diabetes patients because the study was intended to focus on these two forms of diabetes. This age range was determined using data from the literature (Sandberg *et al.* 2000, Ogunbodede *et al.* 2005, Campus *et al.* 2005), as well as additional study discussed in (Taylor *et al.* 1998).

3.1.2 Criteria for inclusion

Patients aged 25 to 75 years old who were dentate, had at least 10 teeth, and presented to the outpatient department or the diabetes clinic were considered.

3.1.3 Criteria for exclusion

All patients under the age of 25 and over the age of 75, as well as those who were edentulous.

3.1.4 Selection of study participants

The research participants were chosen using a convenience sampling method. As patients came at the hospital for a consultation, those who satisfied the inclusion criteria were enrolled. Non-diabetic people who visited the outpatient department for medical consultations throughout the research period were selected. Patients with diabetes were identified as those who brought their records to a clinic for diabetics in order to receive diabetes medication.

3.1.5 Sample size estimation

Raosoft statistical software was used to compute the sample size under the following presumptions: An 80 from 100 sample size is recommended with a population size of 50, a 95 percent of overall confidence interval, a 5 percent on average margin of error, and a 50% response distribution.

As a result, 100 patients were required in each group (two independent samples). The study included 100 participants (50 diabetics and 50 non-diabetics) who visited MMCH between July and September 2021.

3.1.6 Piloting the questionnaire

Ten people were assessed on the completed questionnaires in May 2021. The purpose of the pilot research was to:

- Test the applicability of the data collection technique.

- Check the questionnaire's sufficiency.
- Verify that each question was explicit and clear.
- Any items that didn't give useful info should be removed.

3.1.7 Data collection

The information was gathered using questionnaires and data collecting sheets with both ajar and firmly shut questions. They were created to ensure that they were simple, clear, and unambiguous, and that they fit the study's goals. The questionnaire was first planned in March of 2008. It was developed as a consequence of discussions in a group comprising diabetes patients and the medical personnel who look after them. The questions were created after a careful examination of the literature.

Oral health status, demographics, and oral issues were the three categories into which the questionnaire data was separated. The diabetic group was questioned on the length of their disease, their prior dental health, and their general quality of life following their diagnosis. A data collection sheet and a questionnaire were used in the investigation's data gathering by the principal investigator, a licensed dentist who is multilingual in Arabic and English.

When patients consented to take part in the experiment, a licensed dentist performed an oral examination to establish their current state of oral health. The researcher then explained the study's objectives to the participants. With a wooden spatula and a dental mirror explorer probe, the oral examination was performed in broad daylight. In that sequence, the gingiva, teeth, and plaque index were checked.

3.2 Methods of Mouth Examination

3.2.1 Plaque index (PI)

For the purposes of his study, the plaque index, which was based on Greene and Vermillion's (1964) debris index, was utilized to determine the coronal extension of plaque. A total of six teeth were examined for each subject. In this study, it was thought to be a precise and trustworthy indicator for measuring oral cleanliness.

3.2.2 Criteria and codes

0 = stands meaning "nothing" (There are no spots or detritus).

1 = when mushy debris only fills a third of the the tooth's surface under study or when extrinsic stains are present but soft debris is absent, regardless of the surface area covered.

2= There is soft material covering more than one-third, but not more than two-thirds, of the visible tooth surface.

3= Soft tissue covers and over pair of the visible tooth surface.

4= not recorded.

3.2.3 Gum index (GI)

The condition of the gums is based on (Loe and Silness 1963). The gingiva was visually examined for size, color, ulceration, and spontaneous bleeding, and by gently probing the gingival sulcus's soft tissue wall, the GI was examined. On a scale of 0 to 4, the mesial, buccal, distal, and lingual gingival tissues were scored individually as follows:

0 = g are empty.

1 = There is mild gingivitis, color is slightly different and swollen.

2 = There is visible gingivitis, pink and glowing.

3 = There is a red band that is fully visible on the gingiva from fly to another.

4= Severely swollen, very red & swollen, until ulcers and spontaneous bleeding.

3.2.4 Mobility index (MI)

Each tooth was placed between both the sides of two metallic objects to inspect the patient's mouth. The results were as follows:

- Grade 0: no discernible tooth movement
- Grade 1: tooth movement that differs significantly from what is typical
- Grade 2: crown displacement in the lateral direction of more than one millimeter
- Grade 3: having the capacity to push the teeth vertically

3.3 Data Analysis

The data were examined using SPSS 25 (Statistical Package for Social Sciences). The Alpha test was used to evaluate the inter-examiner reliability. Descriptive statistics, such as frequency and percentage, were generated for demographic and clinical parameters. Chi-square analysis and a separate sample the differences in categorical and continuous variables between the cases and controls, as well as potential confounding factors, were examined using T tests.

4. RESULTS AND DISCUSSION

This chapter discusses the study's findings. Following the presentation of demographic data, a comparison of the oral health state of those with and without diabetes individuals is made to ascertain the impacts of poorly managed diabetes on periodontal tissue health. To make diabetics aware of the significance of seeing the dentist and getting a regular periodontal checkup, as well as maintaining good oral hygiene.

4.1 Demographic Information

The demographic data of the research participants by diabetes disease status is shown in Table 4.1. In the trial, 100 patients participated (50 diabetic and 50 non-diabetic). Nearly 36% of participants in each group and 64% of research participants overall were men. For the diabetic and non-diabetic groups, the gender distribution was comparable ($P = 0.06$). For diabetes and non-diabetic individuals, all of the variable distributions were not statistically meaningful ($P > 0.05$).

Table 4.1 Demographic data based on the presence or absence of diabetes

Variable	Category	Disease status				P-value
		Diabetic (n=50)		Non-diabetic (n=50)		
		Freq	%	Freq	%	
Gender	Male	16	32.0	20	40.0	0.07
	Female	34	68.0	30	60.0	
Age	18-22	12	24.0	4	8.0	0.405
	22-27	9	18.0	15	30.0	
	28-32	12	24.0	20	40.0	
	33-37	10	20.0	7	14.0	
	More than 37	7	14.0	4	8.0	
Occupation	Student	11	22.0	11	22.0	0.789
	Employed	19	38.0	21	42.0	
	Housewives	14	28.0	10	20.0	
	Businessman	6	12.0	8	16.0	
Education	No formed	4	8.0	7	14.0	0.410
	Primary	3	6.0	1	2.0	
	Secondary	19	38.0	14	28.0	
	University or college	24	48.0	28	56.0	

4.2 Oral Health Status

4.2.1 Plaque index

The plaque index is shown in both diabetic and non-diabetic individuals in Table 4.2. The plaque index and the occurrence of diabetes were statistically significantly correlated ($P < 0.000$). Compared to non-diabetics, diabetic individuals had a plaque index that was greater than 1/3 and less than or equal to 2/3. (64 percent vs. 6 percent).

Table 4.2 Plaque index by diabetic disease status

Variable	Category	Disease Status				P-value
		Diabetic (n=50)		Non-diabetic (n=50)		
		Freq	%	Freq	%	
Plaque Index	None	3	6.0	32	64.0	0.000**
	< 1/3	13	26.0	14	28.0	
	> 1/3 and ≤ 2/3	32	64.0	3	6.0	
	More than 2/3	2	4.0	1	2.0	

** p < 0.01

Gums index

Figure 4.1 depicts how the gums index looks in diabetic versus non-diabetic people. In comparison to 6% of diabetes patients, one-fifth of the non-diabetic patients (20.0 percent) had an empty gingival index. The majority of diabetes individuals had moderate gingivitis with a slightly different hue and inflamed gums (18.0 percent). The majority of diabetes patients were in the red band that runs from one fly to the next on the gingiva (4.0 percent).

In comparison to non-diabetic patients, diabetes patients exhibited greater prevalences of evident gingivitis, pink and shiny, and extremely swollen, very red & swollen, until ulcers, and spontaneous bleeding (12.0% vs. 7.0%) and (10.0% vs. 5.0%), respectively. The gums index and diabetes status had a statistically significant relationship ($P = 0.023 < 0.05$). Diabetes patients showed moderate gingivitis, slightly different color, and

swollen gums when compared to non-diabetics (36 percent vs. 32 percent), according to Table 4.3.

Table 4.3 Gums index by diabetic disease status

Variable	Category	Disease Status				P-value
		Diabetic (n=50)		Non-diabetic (n=50)		
		Freq	%	Freq	%	
Gums Index	Empty	6	12	20	40	0.023*
	Mild gingivitis, color is slightly different and swollen	18	36	16	32	
	Visible gingivitis, pink & glowing	12	24	7	14	
	Red band that is fully visible on the gingival from fly to another	4	8	2	4	
	Severely swollen, very red and swollen, until ulcers and spontaneous	10	bleeding 20	5	10	

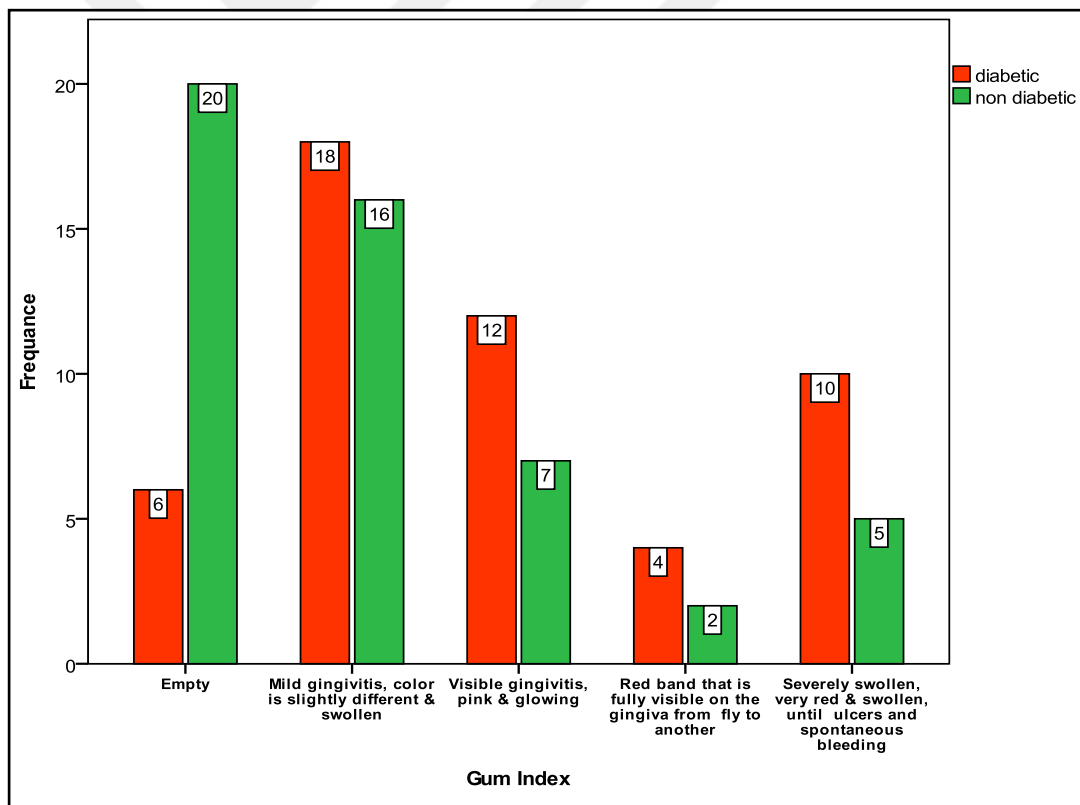


Figure 4.1 The emergence of gingiva index in DM and non-diabetic individuals

4.2.2 Mobility index

88.0 percent of non-diabetic patients and 62.0 percent of diabetic patients reported grade 1 (distinctive tooth mobility from the norm), while grade 2 (crowned of dental shifts over than 1 mm in a lateral direction) was reported by 62.0 percent of diabetic patients (32.0 percent and 12.0 percent). Grade 3 symptoms were experienced by 6.0 percent of diabetes patients and 0.0 percent of non-diabetic individuals (both the capacity to depress the tooth in a vertical direction and lateral movement of more than 1 mm).

Table 4.4 Mobility index by diabetic disease status

Variable	Category	Disease Status				P-value
		Diabetic (n=50)		Non-diabetic (n=50)		
		Freq	%	Freq	%	
Mobility index	Grade1	31	62	44	88	0.007**
	Grade2	16	32	6	12	
	Grade3	3	6	0	0	

4.3 Oral Pathology

Table 4.5 compares the oral pathology issues of diabetic and non-diabetic people. Diabetes status and mouth pain were statistically associated ($p = 0.000$). Diabetic patients reported pain in the mouth "sometimes" more frequently than non-diabetic patients (56.0 percent vs 20.0 percent), with one-third of diabetics reporting discomfort "often" compared to ten percent of non-diabetic patients. Diabetes status and months with any mouth pain or discomfort in the previous year were statistically significantly associated ($P = 0.004$). Two-fifths of diabetics reported experiencing pain or discomfort in the mouth "often" in the preceding year compared to ten percent of non-diabetic patients, while diabetic patients described oral pain in the mouth "occasionally" more frequently than non-diabetic patients (44.0%). The difficulty swallowing dry meals and diabetes status had a statistically significant relationship ($P = 0.026$). Yes and no answers were given concerning problems with difficult-to-swallow dry meals. Non-diabetic individuals said "No" more often than diabetes patients when it came to swallowing dry meals (82.0 percent vs 62.0 percent). In comparison to fewer than 20% of non-diabetic patients, 38.0 percent of diabetes patients "yes" reported difficulty

swallowing dry meals. There was no statistically significant link between the sort of pain or discomfort you were experiencing and your diabetes status ($P = 0.589$). Sharp feeling, throbbing, dull aching, burning hot or scalded, and tingling were the forms of pain or discomfort you experienced. When comparing diabetic and non-diabetic individuals, non-diabetic patients reported higher "throbbing" pain (37.5 percent vs 15.2 percent). In comparison to 30.0 percent of non-diabetic patients, 30.4 percent of diabetes patients had "Sharp feeling" type of pain or discomfort. The association between having a dry mouth after eating a meal and having diabetes was not statistically significant ($p = 0.656$). Yes and no answers were given to the question of feeling dry when eating a meal. Non-diabetic patients reported feeling more "No" when eating a meal than diabetic individuals (74.0 percent vs 70.0 percent). When it came to feeling dry while eating a meal, 30.0 percent of diabetes patients said "Yes," compared to 26.0 percent of non-diabetic patients. A non-statistically causal link between having diabetes and having problems with your sense of taste ($p = 0.394$) was found. Diabetic patients reported having a sense of taste "sometimes" more than non-diabetic patients (82.0%), with 5.0% of non-diabetics reporting having a sense of taste "frequently" compared to 4% of diabetes patients.

Table 4.5 Comparison of oral pathology by diabetic disease status

Variable	Category	Disease Status				P-value
		Diabetic (n=50)		Non-diabetic (n=50)		
		Freq	%	Freq	%	
Oral discomfort	Never	7	14.0	30	60.0	0.000
	Sometimes	28	56.0	10	20.0	
	Often	15	30.0	10	20.0	
Have you had any oral pain or discomfort in the past year?	Never	5	10.0	18	36.0	0.004
	Sometimes	25	50.0	22	44.0	
	Often	20	40.0	10	20.0	
What kind of discomfort or pain do/did you experience?	Sharp sensation	14	30.4	6	30.0	0.589
	Throbbing	13	15.2	12	37.5	
	Dull ache	7	28.0	6	18.8	
	Burning hot or scalded	9	19.6	5	15.6	
	Tingling	3	6.5	3	9.4	
Dry mouth after eating a meal	Yes	15	30.0	13	26.0	0.656
	No	35	70.0	37	74.0	
having difficulty swallowing dry meals	Yes	19	38.0	9	18.0	0.026
	No	31	62.0	41	82.0	
experiencing issues with your palate	Never	7	14.0	36	72.0	0.394
	Sometimes	41	82.0	9	18.0	
	Often	2	4.0	5	5.0	

4.3.1 Practices in general health and oral hygiene

As demonstrated in Table 4.6, the results suggested that the questioned group had poor health-related behaviors.

Very 10.0 percent of individuals exercised every day, whereas 58.0 percent exercised only sometimes and 32.0 percent never did.

Only 12.0% of the participants said they had a recent blood glucose test the week before the interview; 22.0% reported having a glucose test within the previous month, 24.0 percent said they had a glucose test within the last three months, and 42.0 percent said they had a glucose test on their need.

Just 14.0% of participants regularly saw a dentist, despite the fact that 84.2% of them had follow-up medical visits in the year prior.

The majority of respondents (46.0%) cleaned their teeth once a day, 38.0% twice a day, and 10.0% more than twice everyday when it came to oral hygiene practices.

Table 4.6 shows that although almost half of the participants (44.0%) were aware that diabetics are more likely to suffer gum problems if their blood sugar levels remain high, only 30.0% were aware that gum disease makes it more difficult for diabetic patients to regulate their blood sugar.

Nearly half of participants (42.0%) were aware that people with diabetes are more likely to have periodontal disease than those without diabetes, and the majority of participants (68.0%) were aware that people with diabetes who smoke are more likely to develop severe gum disease than non-smokers with diabetes.

Table 4.6 Practices in general health and oral hygiene

Diabetic (n=50)			
Variable	Category	F	%
Exercise	Daily	5	10.0
	Rarely	29	58.0
	None	16	32.0
Glucose test	Daily	0	0.0
	Weekly	6	12.0
	Monthly	11	22.0
	After three months	12	24.0
	At the necessary	21	42.0
seen a doctor recently for follow-up treatment	Yes	42	84.0
	No	8	16.0
Dental visits	Regularly	7	14.0
	On need	43	86.0
Brushing frequency	Never	3	6.0
	Once a day	23	46.0
	Twice a day	19	38.0
	More than twice a day	5	10.0
If a diabetic's blood sugar level stays high, gum issues will occur more frequently.	Yes	22	44.0
	No	28	56.0
Gum disease makes diabetes blood sugar control more difficult	Yes	15	30.0
	No	35	70.0
Compared to non-smokers, diabetic smokers have more severe gum disease.	Yes	34	68.0
	No	16	32.0
Gum disease is just as likely to affect persons with diabetes as it is people without diabetes.	Yes	21	42.0
	No	29	58.0

According to Table 4.7, those with greater levels of education were not significantly more aware of diabetes and periodontal disease than people with lower levels of education ($P = 0.097$).

Those who consistently exercised and saw their doctors in the previous year did not significantly have a better understanding of the link between periodontal disease and diabetes ($P > 0.05$).

Additionally, those who said they often saw the dentist were more likely to understand the link between diabetes and periodontal disease ($P < 0.05$).

Table 4.7 Participants' health awareness and behavior

Variable	Category	Awareness on the periodontal–diabetes association		P-value
		Mean Rank	Ch-Square	
Education	No formed	18.25	6.312	0.097
	Primary	12.00		
	Secondary	25.16		
	University or College	28.67		
Exercise	Daily	10.28	7.25	0.078
	Rarely	29.21		
	None	22.54		
Physician visits during last year	Yes	28.70	8.25	0.051
	No	24.65		
Dental visit	Regularly	29.31	10.25	0.001
	Only when needed	9.25		

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In a group of 50 diabetic and non-diabetic patients at Misrata Medical Center Clinic in Libya, the purpose of this study was to ascertain the effect of uncontrolled diabetes on periodontal tissue health and to inform diabetics about the significance of going to the dentist, getting a regular periodontal checkup, as well as maintaining good oral hygiene.

In this study, diabetes patients had lower oral health than their non-diabetic counterparts. Given that diabetes weakens the immune system, diabetic patients experienced more oral lesions than non-diabetic patients.

Almost everyone who took part was a Libyan. According to the study, people aged 28 to 37 are more likely to have oral health issues. The study's findings consistently shown that those with diabetes had more oral health issues than those without the disease.

Nearly two thirds of those with diabetes had a plaque index of higher than one third. These outcomes are comparable to those obtained by Sandberg *et al.* (2000) who measured plaque using the Plaque management record approach., compared two patients with diabetes to two non-diabetic patients and discovered that diabetic patients had higher levels of bacterial plaque on their surfaces than non-diabetic patients (Sandberg *et al.* 2000). Our outcome corresponds to (Rylander *et al.* 1987, Thorstensson *et al.* 1993). Other researchers, like (Goteiner *et al.* 1986 and Hayden *et al.* 1989), found no appreciable variations in these measures between diabetic and non-diabetic participants.

People with and without diabetes were given the gums index, and a statistically meaningful correlation between both the gums index and diabetes status was found. Our outcome corresponds to what we expected (Bridges *et al.* 1996, Sznajder *et al.* 1978).

In this study, the pattern of dental mobility was examined using Miller's tooth mobility index. It was found that they were movable, with grade 1 accounting for the majority of them (62.0) percent. The only treatments required for Grade I mobility are having their doctor set up adequate diabetes management, undergoing local periodontal therapy with or without occlusal adjustment, and strengthening at-home plaque control. Accelerated alveolar bone loss in diabetes patients compared to non-diabetics highlights the deterioration of dental support, which presents as tooth/teeth movement, according to Javed *et al.* 2012, Taylor *et al.* 1998).

Diabetes is the primary cause of tooth death in a population that prefers symptomatic rather than preventative dental treatment, since Grade 3 mobility, which necessitates tooth extraction, accounted for 6.0 percent of all tooth deaths. The primary periodontal causes of tooth loss have been identified as mobility, followed by fractional involvement (Ong 1998).

Diabetic individuals reported having greater difficulties with their teeth "sometimes" or "often" than non-diabetic patients in this study. The most common complaint among diabetics was pain in the mouth. These findings may be due to the higher prevalence of oral pathology in diabetes patients, including tooth decay and periodontal disease, both of which are linked to discomfort and suffering. Caries and tooth soreness were the most prevalent dental issues mentioned by diabetes and non-diabetic individuals, respectively. There is a lack of uniformity in the literature when it comes to the association between diabetes and dental caries. Some researchers (Lamster *et al.* 2008, Mealey and Oates 2006, Zielinski *et al.* 2002) found that diabetes individuals had greater levels of dental caries. Numerous studies have connected xerostomia or elevated gingival crevicular fluid glucose levels to higher risks of dental caries (Mealey and Oates 2006).

The majority of diabetes patients stated that their sense of taste was impaired. Although not all researchers have documented taste changes in DM patients, some have. It is probably brought on by alterations in food consumption and a reduction in salivary flow as a result of the therapy for diabetes (Lamster *et al.* 2008).

In order to compare gustation appreciation on the right and left sides of the tongue and soft palate, Gondivkar et al. (2009) evaluated the function of the gustatory system in persons with type 2 diabetes mellitus. 40 type 2 diabetes patients with their condition under control and 40 without made up the research group. 40 healthy control participants who were matched for age and gender also received testing.

To evaluate gustatory function, a spatial tasting test, one whole above-threshold test, and liquids containing sugar, sodium chloride (NaCl), citric acid, and quinine hydrochloride were all employed. With the use of Student t tests and 1-way ANOVA, statistical analysis was carried out. Their findings demonstrated that, in comparison to healthy control participants, both managed and uncontrolled diabetes patients had taste impairment.

There was a very noticeable contrast between the sweet and sour flavors. There was a noticeable variation in salt flavor. On the left and right sides of the tongue and soft palate, virtually all 120 participants had approximately equal taste sensitivity. Reduced reactions to salt, sour, and sweet tastes have been described in patients with type 2 diabetes. This taste oddity, which tends to favor sweet-tasting foods, may influence the choice of nutrients, exacerbating hyperglycemia.

Most of these diabetes patients saw their doctors in the preceding year, but they were not as active about scheduling dental visits, with just a tiny fraction going regularly.

The present study's low compliance with normal dental exams is comparable to a recent study of female Saudi adults, which found that only 8% of female diabetes patients attended their dentist on a regular basis. Only 10% of diabetes patients in Jordan who were questioned (Awartin *et al.* 2009) and their study attended their dental appointments on a regular basis (Al Habashneh and others 2010). Our compliance scores with dental visits are lower than those in comparable studies (Allen *et al.* 2008). The differences among our research and those others, which were carried out in Western nations, might be attributed to the various populations evaluated.

Based on the results of their doctor and dentist visits, this study amply demonstrates that tooth health is not a top priority for this group of diabetes patients. Furthermore, dental checkups were not as well-attended as in Western countries. Therefore, all diabetes clinics ought to advise diabetic patients to go to the dentist frequently in order to refresh and receive education in oral health knowledge. Diabetes patients must also be informed about the systemic and oral problems of the condition in order to fulfill the US public health goal of having 71 percent of them have an annual dental checkup by 2010 (Centers for Disease Control and Prevention 2005).

Mohamed et al. (2013) looked at the relationship between adult-onset type 2 diabetes and oral health. This study's goal was to examine the clinical and self-reported oral health indicators between people with type 2 diabetes (T2DM) and non-diabetic controls who were the same age and gender. Additionally, clinical and subjective oral health markers that may be used to differentiate between T2DM patients with well-managed and poorly-controlled conditions, as well as between those who have had the illness for a long or short time, were also sought out. The poll involved 457 people in total (154 T2DM cases and 303 non-diabetic controls).

Depending on the level of metabolic regulation [(well-controlled: glycosylated haemoglobin test \leq 8%), (poorly controlled: glycosylated haemoglobin test $>$ 8%)] the T2DM group was split into two groups based on the T2DM length (small period: ten years), (high levels: more than ten years)]. Interviews with the participants were conducted using a standardized questionnaire that inquired about sociodemographics, manner of life, and life quality in connection to dental health.

The clinical examination included coronal and root surface caries, furcation involvement, plaque index, tooth mobility index, and full mouth probing depths. This study found that T2DM patients had higher rates of chronic periodontitis, tooth mobility, furcation involvement, and OIDP than non-diabetic controls.

This research clearly shows that individuals only wash their teeth once a day, indicating that oral hygiene is not a common habit in this group. In order to improve periodontal health and avoid gingival problems in this high-risk group, proper oral hygiene habits should be encouraged along with instruction on how to utilize them. Other researchers have found similar findings of poor oral hygiene in diabetes individuals (Al Habashneh *et al.* 2010, Bakhshandeh *et al.* 2008, Eldarrat *et al.* 2011).

The findings imply that patients at the MMC Hospital's diabetic clinic were well-informed about diabetes in general. It's possible that their awareness of general diabetic things stems from their regular medical appointments. Only 44% of participants knew that diabetes and periodontal disease are related, despite the fact that patients with diabetes are more likely to develop gum issues if their blood sugar levels remain high. These findings suggest that study participants were less aware of the potential link between gingival illness and diabetes, as well as the fact that diabetes increased periodontal disease risk.

Given their overall awareness of diabetes, it is interesting that the study's diabetic population demonstrated a lack of comprehension of the connection between periodontal disease and diabetes. This outcome was in line with other research' results, which showed a lack of understanding of the connection between diabetes and periodontal disease (Awartin *et al.* 2009, Allen *et al.* 2008, Jansson *et al.* 2006, Masood Mirza *et al.* 2007).

This survey demonstrates that diabetes and periodontal disease are poorly understood. As a result, diabetics need to know more about their risk of developing periodontal disease and understand how important dental health is to their overall health and wellbeing. Without health education, increasing awareness and thereby modifying health-related behavior and preventing consequences is impossible.

Health education aims to modify behavior by influencing a person's awareness, attitudes, and beliefs about health issues (Morgan *et al.* 2011, Tsai *et al.* 2002), in order to engage patients in self-care (World Health Organization 1994). Only a small number

of research on the influence of diabetic health education on metabolic control have been carried out in Libya, and almost all of them assessed the part that knowledge and involvement in an educational program had in patients' glycemic control (Al-Shahrani *et al.* 2012, Elzubier *et al.* 1996, Uddin *et al.* 2001).

As a result of our findings, additional study in Libya is required to uncover the barriers to diabetes patients' understanding and compliance. Further research may encourage insurance providers, government and private health care providers to establish a system that permits all diabetics to have yearly dental appointments.

5.2 Recommendations

Diabetic individuals experienced greater oral health concerns than non-diabetic patients, according to the findings of this study. According to this study:

1. Encouraged to visit a dentist frequently to make sure their mouths are as healthy as possible. This will enable them to adhere to a diabetic patient's nutritional recommendations. The dental team has the potential to have a substantial beneficial impact on the oral and overall health of diabetic patients. This may indicate the need for more specialized interventions that educate diabetic patients about oral health problems.
2. To help diabetics maintain normoglycemia, which impacts the emergence of diabetes complications and, therefore, the overall quality of life, diabetic intervention techniques are necessary. Due to the possibility that these will be the initial warning signs or symptoms of an undiagnosed or poorly managed diabetes disease in the oral cavity, dentists and dental hygienists need to be aware of these symptoms and know what to do if they appear.
3. Focuses on raising awareness of the link between diabetes and periodontal disease and the necessity for multidisciplinary diabetes therapy among diabetologists and periodontists. Despite the fact that a report on the understanding of the relationship between diabetes and periodontal diseases revealed a significant knowledge gap as well as a lack of appreciation for the necessity of collaborative management of

diabetic patients by medical and dental practitioners, more work should be put into improving knowledge and putting it into practice for the best care of diabetic patients.

4. Oral health promotion initiatives are desperately needed by the general population so that people are aware of any mouth problems and comprehend the close connection and reciprocal interaction between oral health and diabetes. This will help people provide better care for family members who have diabetes and help them deal with diabetes if they ever have it.
5. Future studies on diabetic patients must examine the mobility index, loss of attachment, CPITN index, and glycolic control and assess how the results relate to the patient's type of diabetes, medicines, and length of diabetes. Also These results of inadequate understanding of periodontitis and diabetes suggest that this issue is currently being ignored, and quick action should be made.

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