

**Salivary flow and sweet tasting
threshold in diabetes mellitus:
Controlled versus uncontrolled
patients**

*Thesis submitted to the Faculty of Oral and dental Medicine ,
Cairo University, for the registration of the Master Degree of
Dental Science*

(Oral Medicine, Oral Diagnosis and Periodontology Department)

By

Sherine Fathi Ahmed Osman

B.D.S

*Faculty of Oral and Dental Medicine
Cairo University
2009*

Supervisors

Prof. Dr. Atef EL-Shahat Atia

*Professor of Oral Medicine and Periodontology
Faculty of Oral and Dental Medicine, Cairo University*

Prof. Dr. Samar EL-Kholy

*Professor of Oral Medicine and Periodontology
Faculty of Oral and Dental Medicine, Cairo University*

معدل إفراز اللعاب وحاسة التذوق للسكريات في
مرضى السكر: دراسة مقارنة بين المرضى تحت
العلاج والمرضى بدون علاج

رساله للحصول على درجة الماجستير بقسم
طب الفم وأمراض اللثة

مقدمه من

الطبيبة / شيرين فتحي أحمد عثمان
طبيب حر

كلية طب الفم و الأسنان
جامعة القاهره

٢٠٠٩

المشرفون

ا.د. عاطف الشحات عطيه

استاذ بقسم طب الفم وأمراض اللثة
كلية طب و جراحة الفم و الأسنان
جامعة القاهرة

ا.د. سمر الخولي

استاذ بقسم طب الفم وأمراض اللثة
كلية طب و جراحة الفم و الأسنان
جامعة القاهرة

Abstract

Diabetes mellitus is considered a common metabolic disorder of heterogeneous etiologies. It is a multifactorial disorder.

Diabetes mellitus has many related general complications as diabetic neuropathy, retinopathy and nephropathy. Its oral complications include periodontitis, abscesses, increase liability to infection, decrease in salivary flow and affection of taste sensation.

Control of diabetes would influence salivary flow rate both resting and stimulating. Saliva protects the integrity of the soft and hard tissue inside the oral cavity, and affects taste perception especially sweet taste perception.

Key Words: Diabetes Mellitus- Salivary flow- Taste perception- Hyperglycemia – Diabetic neuropathy – Gustatory taste score- Taste buds.

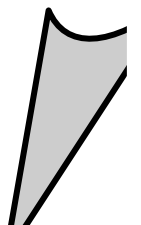
Acknowledgement

First and foremost, I am always indebted to "**Allah**" the kindest and the most merciful.

I would like to express my sincere gratitude to **Prof. Dr. Atef EL-Shahat Atai**, Professor of Oral medicine, Oral Diagnosis and Periodontology , Faculty of Oral and Dental Medicine, Cairo University for his continuous guidance and supervision in criticizing and correcting the whole thesis and encouragement which he always offered willingly. To him I extend my sincere thanks.

I would like to express my deep gratitude to **Prof. Dr. Samar EL-Kholy**, Professor of Oral medicine , Oral Diagnosis and Periodontology, Faculty of Oral and Dental Medicine, Cairo University for her continuous help, active support and guidance throughout every step in this work which without her advices this work would not be completed.

Finally, my whole gratefullness are extended to all members of Oral Medicine, Oral Diagnosis and Periodontology Department .



LIST OF CONTENTS

| Content | Page |
|--|-----------|
| Introduction & Review of Literature | 1 |
| DIABETES MELLITUS | |
| ✚ <i>Diagnosis of diabetes mellitus</i> | 4 |
| ✚ <i>Pathogenesis of diabetes mellitus</i> | 5 |
| ✚ <i>Pathogenesis of type I diabetes</i> | 6 |
| ✚ <i>Pathogenesis of type II diabetes</i> | 7 |
| ✚ <i>Diabetic complications</i> | 8 |
| ✚ <i>Oral complications of diabetes mellitus</i> | 11 |
| SALIVARY FLOW | |
| ✚ <i>Saliva components and functions</i> | 16 |
| ✚ <i>Methods for saliva collection</i> | 19 |
| TASTE | |
| ✚ <i>Abnormalities of taste sensation</i> | 27 |
| ✚ <i>Classification of taste disorders</i> | 27 |
| ✚ <i>Methods of taste testing</i> | 32 |
| Aim of the Work | 34 |
| Subjects and Methods | 35 |
| Results | 42 |
| Discussion | 79 |
| Conclusion & Recommendations | 91 |
| Summary | 92 |
| References | 94 |
| Arabic Summary | - |

LIST OF FIGURES

| Figure No. | Description | Page No. |
|------------|---|----------|
| 1 | Sweet tastant with different concentrations (score 1-6) | 40 |
| 2 | A dropper was used to apply a few drops of each solution on the tip of the dorsal surface of the tongue | 40 |
| 3 | Resting salivary flow | 41 |
| 4 | Funnel inserted into graduated collection test tube | 41 |
| 5 | Histogram showing the mean age of the different study groups | 44 |
| 6 | Histogram showing the HbA1C values in the different study subjects | 46 |
| 7 | Histogram showing gustatory test score in the study groups | 50 |
| 8 | Histogram showing salivary flow (RSF, SSF) in the study groups | 50 |
| 9 | Histogram showing gustatory test score in type I DM controlled and uncontrolled | 56 |
| 10 | Histogram showing salivary flow (RSF, SSF) in type I DM controlled and uncontrolled | 56 |
| 11 | Histogram showing RSF and SSF in uncontrolled type I DM and the control group | 59 |
| 12 | Histogram showing gustatory test score in uncontrolled type I DM and the control group | 59 |
| 13 | Histogram showing gustatory test score in controlled type I DM and the control group | 62 |
| 14 | Histogram showing RSF, SSF in controlled type I DM and the control group | 62 |
| 15 | Histogram showing gustatory test score in type II DM controlled and uncontrolled | 65 |

| | | |
|----|--|----|
| 16 | Histogram showing salivary flow (RSF, SSF) in type II DM controlled and uncontrolled | 65 |
| 17 | Histogram showing gustatory test score in uncontrolled type II DM and the control group | 68 |
| 18 | Histogram showing RSF, SSF in uncontrolled type II DM and the control group | 68 |
| 19 | Histogram showing gustatory test score in controlled type II DM and the control group | 71 |
| 20 | Histogram showing RSF-SSF in controlled type II DM and the control group | 71 |
| 21 | Histogram showing gustatory test score in type I and type II DM both controlled and uncontrolled | 76 |
| 22 | Histogram showing salivary flow (RSF, SSF) in type I and type II DM both controlled and uncontrolled | 76 |

LIST OF TABLES

| Table No. | Description | Page No. |
|-----------|--|----------|
| 1 | Comparison between age in the study groups | 44 |
| 2 | Comparison between HbA1C values in the different study subjects. | 46 |
| 3 | Descriptive statistics for all variables under study. | 49 |
| 4 | Comparison between the means of gustatory test score, RSF and SSF of the study groups. | 53 |
| 5 | Statistical analysis of uncontrolled and controlled type I DM. | 55 |
| 6 | Comparison between uncontrolled type I DM and the control group | 58 |
| 7 | Comparison between controlled type I DM and the control group | 61 |
| 8 | Statistical analysis of uncontrolled and controlled type II DM | 64 |
| 9 | Comparison between uncontrolled type II DM and the control group | 67 |
| 10 | Comparison between controlled type II DM and the control group | 70 |
| 11 | Comparison between uncontrolled type I and type II DM | 73 |
| 12 | Comparison between controlled type I and type II DM | 75 |
| 13 | Correlation between RSF and different variables | 77 |
| 14 | Correlation between SSF and different variables | 78 |

LIST OF ABBREVIATIONS

| | |
|---------------------|---|
| <i>DM</i> | Diabetes mellitus |
| <i>NIDDM</i> | Non insulin dependent diabetes mellitus |
| <i>IDDM</i> | Insulin dependent diabetes mellitus |
| <i>GDM</i> | Gestational diabetes mellitus |
| <i>WHO</i> | World health organization |
| <i>FDR</i> | First degree relative |
| <i>ADA</i> | American diabetes association |
| <i>HLA</i> | Human leucocyte antigen |
| <i>AGEs</i> | Advanced glycatoin end products |
| <i>DKA</i> | Diabetic ketoacidosis |
| <i>USFR</i> | Unstimulated salivary flow rate |
| <i>HbA1C</i> | Glycosylated haemoglobin |
| <i>RSF</i> | Resting salivary flow |
| <i>SSF</i> | Stimulated salivary flow |

Aim of the study

The present study was carried out to compare the salivary flow rate and sweet taste sensation in type I and type II DM, both controlled and uncontrolled patients.

Discussion

DM comprises a syndrome of common metabolic disorders that share the phenotype of inappropriate hyperglycemia. It is associated with irregularities in the metabolism of carbohydrates, lipids, and proteins, and susceptibility to the development of specific forms of premature renal, ocular, neurological, and cardiovascular diseases (*De Lima et al., 2008; Sun et al., 2008*).

DM is one of the most prevalent diseases worldwide and is commonly found in dental patients. Patients with a diagnosis of DM present a higher susceptibility to infections due to deficiency in PMNs, as a result of vascular alterations and neuropathies (*Varon & Mackshipman, 2000; De Lima et al., 2008*).

Diabetic patients, especially those with poor control of glycemia, suffer from disorders such as xerostomia, impairment of taste, periodontal diseases and oral candidosis (*Sandberg et al., 2000; Lamers et al., 2007*). In addition, other oral manifestations have been reported, such as ketonic breath (sweet breath), higher residual bone resorption, loss of oral mucosal resilience which is necessary for good adaptation of a complete denture and tissue regeneration times above normal (*Soysa et al., 2006; Owen & McCarthy, 2007*).

Saliva exerts a fundamental role in the maintenance of oral health (*Amerongen & Veerman, 2002*). Saliva aids in digestion, mastication, oral microbial defense, lubrication, speech, deglutition and preservation of mineralized and mucosal tissues. Also, saliva is the principle fluid component of the external environment of the taste receptor cells and as

such, could play a role in taste sensitivity. Its main role includes transport of taste substances and protection of taste receptor. These functions are essential for the maintenance of oral and pharyngeal health and a comfortable quality of life (*Mata et al., 2004*).

Xerostomia is a common complaint among diabetic patients, which is closely connected to polydipsia. Xerostomia is associated with damage to salivary gland activity, resulting in marked decrease in their ability to synthesize, transport and secrete saliva (*Moore et al., 2001; Fedirko et al., 2005*).

Disorders of taste have been difficult to diagnose and treat, often because of lack of knowledge and understanding of this sense. Alteration in taste may be a secondary process in various disease states, or it may be the primary complaint (*Noell and Marby, 2002*).

Taste dysfunction may have a significant impact on the quality of life, as deficiency in taste can cause anxiety, depression, and even nutritional deficiencies due to decreased enjoyment of food. Patients frequently report increased use of sugar and salt to compensate for diminished senses of smell and taste, a practice that is detrimental to those with DM or hypertension (*Bromley, 2000; Noell and Marby, 2002*).

Consequently, the present investigation was carried out to compare the salivary flow rate and sweet taste sensation in type I and type II DM, both controlled and uncontrolled patients.

The study was carried out on a total of 250 subjects. 200 individuals suffering from DM compared to 50 healthy subjects. 100 patients suffering from type I DM, 50 patients were controlled type I and

50 patients were uncontrolled type I. 100 patients suffering from type II DM, 50 patients were controlled type II and 50 patients were uncontrolled type II.

Age and gender matching was carried out on choosing the control population in order to avoid any effect on the results. Also, smokers were excluded as smoking is known to affect taste perception. Drug administration was also avoided because some drugs affect both salivary flow and normal gestation (*Fauci et al., 1998; Porter et al., 2004*). Only male subjects were selected in this study due to the fact that hormonal changes occurring in female were found to produce changes in salivary flow rates (*Dodds et al., 2005*).

Both DM patients and control subjects were referred to ENT specialist to exclude gustatory olfactory confusion where olfactory dysfunction is perceived by the patients as loss of taste sensation (*Mott & Leopold, 1991*).

HbA1C values are directly proportional to the concentration of glucose in the blood over the full life time of the red blood cells and therefore reflect mean glycemia over the previous 90 to 120 days. So, HbA1C is the gold standard for assessing and monitoring glycemic control in patients with DM (*Dailey, 2006*).

There was a decreased in the salivary flow rates among subjects with elevated HbA1C values (*Chavez et al. 2001; Moore et al., 2001*).

In order to achieve more accurate diagnosis in our study, HbA1C was measured. The present results agreed with the observation of *Wahba & Chang, (2007)* who stated that the criterion of <7.1% total glycosylated HbA1C, was considered fair to good glycemic control, and