Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 02, 2023

Original Research Article

Taste dysfunction in type 2 diabetes mellitus patients: A Prospective study

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ABSTRACT

Background and aims: The senses of taste and smell are essential determinants of food choice, which in turn may contribute to the development of chronic diseases, including diabetes. Although past studies have evaluated the relationship between type 2 diabetes mellitus (DM2) and senses disorders, this relationship remains controversial.

Materials and methods: This was a observational cross sectional study which was carried over a period of one and half year in the Department of Physiology, Tertiary Care Teaching Hospital. Patients of age above than 30 years and known case of T2DM for more than 5 years of any sex included in study. Type 1 diabetes mellitus patients, smokers and alcoholics, patients on prescribed medicines known to cause taste alteration like sulphonylureas, ace inhibitors, pregnant and lactating women, patients with upper respiratory dysfunction and herpes infection excluded from studies.

Result: The mean taste scores for the tastants: sweet, salty, sour and bitter in Group I were 5.11± 1.99, 6.81± 1.59, 6.81± 1.59 and 5.29± 2.19 respectively, while the mean taste scores in Group II were 4.39± 2.5, 5.40± 2.9, 6± 1.789 and 4± 2.23 respectively. A significant difference ($p < 0.05$) was noticed in the taste scores amongst the two groups. This signifies that obese patients with T2DM respond to a higher concentration for the tastants as compared to non-obese T2DM patients.

Conclusion: Diabetes mellitus (DM) is a common disease which usually manifests in the form of polyuria, polydipsia, weight loss, fatigue, weakness, blurry vision, frequent skin infections, and slow healing of skin lesions.

Keywords: Altered taste, diabetes mellitus, diagnosis.

INTRODUCTION

Taste and smell may influence the acceptance or rejection of food, allowing to recognize chemical characteristics and nutritive substances of ingested food. [1]

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 02, 2023

Previous studies reported that the activation of sensory receptors induces oral and gastrointestinal secretion, contributing to the metabolic and digestive process. [2] Recent findings also showed that ectopic taste and smell receptors could act directly in the regulation of gastrointestinal functions, insulin and glucagon secretion, sense of satiety, and gut motility. [3]

Moreover, the literature suggests that sensory dysfunction, which influences food intake and body weight maintenance, might affect the risk of chronic diseases. [4]

Impairment of taste sensation and reduced gustatory function were observed in patients with type 2 diabetes (DM2). [5] A past work reported that approximately one-third of diabetic subjects present a reduced taste ability (hypogeusia), suggesting that this disorder could inhibit the ability to follow a controlled diet and consequently have good glycemic control. In another study, taste impairment was observed in 80% of uncontrolled diabetic patients and 50% of controlled patients, suggesting a link with glycemic level. More recently, a taste function reduction was observed in DM2 patients with good metabolic control and no signs of neuropathy, retinopathy, or nephropathy. [6] Moreover, an association between sweet taste disorder in diabetes, high daily sugar intake, and vascular complications was also reported. [7]

Regarding olfactory function, a high prevalence of smell impairment in diabetic subjects compared to the general population was observed. [8] A study in an indiscernible sample of patients with type 1 and type 2 diabetes reported that this dysfunction was not associated with glycated haemoglobin (HbA1c) value, duration of diabetes, and micro- and macro-vascular events. [9] Conversely, Gouveri showed that type 2 diabetes was independently associated with olfactory dysfunction and that diabetic peripheral neuropathy and retinopathy were linked with severe smell impairment. Another study also found that smell impairment was correlated with the use of diabetic drugs, specifically insulin.

Several hypotheses on the relationship of taste and smell impairments with diabetes have been advanced. For example, the possible involvement of the reduction of salivary flow and zinc deficiency has been reported. [10] The activation of taste cells by hyperleptinemia secondary to insulin resistance, impairment of brain plasticity within the olfactory system, and the presence of diabetes-related complications (e.g. neuropathy) may represent other involved mechanisms.

However, it is still unclear if the impairment should be considered the cause of the pathology or a related complication, and the correlation between DM2 and taste or smell dysfunctions remains controversial. Moreover, to date, the vast majority of studies have focused only on taste or smell perception (not on both senses). Similarly, most of the literature considered only one or few related diabetes factors.

MATERIALS AND METHODS

This was a observational cross sectional study which was carried over a period of one and half year in the Department of Physiology, Tertiary Care Teaching Hospital.

Patients of age above than 30 years and known case of T2DM for more than 5 years of any sex included in study. Type 1 diabetes mellitus patients, smokers and alcoholics, patients on prescribed medicines known to cause taste alteration like sulphonylureas, ace inhibitors, pregnant and lactating women, patients with upper respiratory dysfunction and herpes infection excluded from studies. Written informed consent was obtained from all enrolled subjects after the procedures were fully explained and prior to the anthropometric parameter measurements and taste test execution. The controls were healthy, non-T2DM volunteers, selected in the same period among hospital healthcare professionals and their relatives, and they were matched for sex, age, and body mass index with patients. All required details about cases such as demographic data (Age, gender, address, registration number etc.), clinical presentation (signs and symptoms) general examination findings, systemic examination taste test were carried out. Blood sample were taken from all patients to check HbA1C, fasting blood

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 02, 2023

sugar, post prandial blood sugar. Diabetes mellitus was defined as an HbA1C>6.5 g% or history of receiving treatment for diabetes mellitus or previously diagnosed diabetes mellitus. **Taste and preparation solutions**

Solutions was prepared as directed below. Each solution were made using a volumetric flask to ensure precision of concentrations to ±0.0002 M. The compounds included were: 1. Quinine (bitter): Place 0.011 g of quinine HCl dihydrate in a 500 ml volumetric flask. Add water to bring the volume to 500 ml, producing a solution with a final concentration of 56 µM. 2. Sodium chloride (salty): Place 7.5 g of sodium chloride in a 500 ml volumetric flask. Add water to bring the volume to 500 ml, producing a solution with a final concentration of 0.25 M. Sucrose (sweet): place 60 g of sucrose in a 500 ml volumetric flask. Add water to bring the volume to 500 ml, producing a solution with a final concentration of 0.35 M and 4. Citric acid (sour): place 25 g of citric acid in 500 ml volumetric flask.

Add water to bring volume to 500 ml, producing a solution with a final concentration of 0.26 M.

Subjects were provided with 4 solutions, a bottle of water, empty cup, pen, and pen-and-paper taste questionnaire samples, 2 subjects were instructed to rate both the intensity and quality (e.g., salty, sour, bitter, sweet, or no flavor) of each tastant and 3 subjects were asked to rinse mouth twice with water and spit it out in the cup provided. After that 5 ml of sample was provided whose nature was kept unknown to the subject and asked to hold it there for 5 seconds before spitting the solution into the cup. After which they were asked to mark the quality and intensity of solutions in the questionnaire scale as mild, moderate and very. Afterward, was asked to rinse mouth with water twice before proceeding to the next sample. **Statistical analysis**

Data was collected and entered in Excel spreadsheet for statistical analysis. Free trial version of SPSS software was downloaded and used for statistical analysis. A $p<0.05$ was deemed as significant. The variables were not normally distributed in the 2 subgroups of the variable group. Thus, non-parametric tests were used to make group comparisons.

RESULTS Table1: Concentrations of the taste stimuli used (g/ml) and the allotted scores

Dilution Steps	Sore	Sucrose (sweet)	Sodium chloride (salty)	Citric acid (Sour)	Quinine hydrochloride(Bitter)
1	1	5	3	4.8	0.05
2	2	3.7	0.10	3.2	0.03
3	3	0.85	0.39	0.15	0.009
4	4	0.59	0.22	0.9	0.0035
5	5	0.28	0.12	0.26	0.0017

Table2: A comparison of taste scores between Group I and Group II

Taste Scores Mean± SD			
Tastant	**Group I**	**Group II**	**P value**
Sweet	5.11± 1.99	4.39±2.5	0.000
Salt	6.81± 1.59	5.40±2.9	0.000

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 02, 2023

Sour	6.81± 1.59	6±1.789	0.001
Bitter	5.29± 2.19	4±2.23	0.002

The mean taste scores for the tastants: sweet, salty, sour and bitter in Group I were 5.11± 1.99, 6.81± 1.59, 6.81± 1.59 and 5.29± 2.19 respectively, while the mean taste scores in Group II were 4.39± 2.5, 5.40± 2.9, 6± 1.789 and 4± 2.23 respectively. A significant difference ($p < 0.05$) was noticed in the taste scores amongst the two groups. This signifies that obese patients with T2DM respond to a higher concentration for the tastants as compared to non-obese T2DM patients. (Table 2)

DISCUSSION

Studies that have shown an increase in prevalence of diabetes in India have also reported a very high prevalence of undiagnosed diabetes in the community. The individuals who are unaware of their disease status are left untreated only to present at a later stage with complications. The disease tends to progress more rapidly in individuals not receiving appropriate intervention. Hence, it is necessary to detect them early and provide necessary treatment. [11]

Taste disorders form a common part of presentation of several diseases. Taste loss may occur in physiological conditions like ageing, pregnancy, and menopause. Patients with xerostomia, Sjögren's syndrome, and zinc deficiency also experience taste loss. Other conditions in which taste loss may occur include liver and kidney disorders, DM, depression, and surgical procedures around the chorda tympani or glossopharyngeal nerve. Patients with head trauma and epilepsy may also experience taste loss.

Numerous drugs (methotrexate, dexamethasone, antihypertensives, and antimicrobial agents) have been associated with taste loss. [12]

` Taste disorders have been described in the past during the course of DM. Le Floch in 1989 had mentioned about the decrease of the diabetic individual's ability to detect and recognize the primary taste modalities. An Indian study in 2012 evaluating 50 cases of DM with oral complications found taste impairment in 20% cases. [13] Another Indian study found that taste alteration was more common in uncontrolled diabetics than in controlled diabetics. [13] Electrogustometric examination in 73 patients from Czech Republic showed that about 40% of type 2 DM have hypoguesia and 5% have aguesia. [14]A 2009 Spanish study concluded that hyperglycemia induces a concentration‐ dependent impairment of sweet taste perception in diabetic patients as the result of an adaptation of the sensory cell to elevated circulating concentrations of glucose. [15]

Newly‐ diagnosed DM patients have a blunted taste response with a preference for sweet‐ tasting foods, which is partially reversed after correction of hyperglycemia, and is independent of somatic or autonomic nerve function. Many mechanisms are being considered, but a specific cause for taste sense alteration is still not known. It is believed that in diabetic patients with complications; neuropathy involving taste nerve tracts and microangiopathy involving taste buds may be responsible for the decreased taste sensation. But in newly diagnosed DM cases without complications, defects in the taste receptor may be responsible. [16]

Disturbance of taste is mostly transient and does not often appear in daily practice. Also patients do not associate taste disturbance with chronic diseases like diabetes or hypertension. In our case, a taste disturbance helped us to diagnose a case of DM before the complications could set in. It is very essential that we specifically ask patients for history of altered taste whenever other risk factors for diabetes are present. Also it is important to give attention to complaints related to taste by any vigilant patient. The risk of Indian patients getting diabetes is evaluated using the Indian Diabetes Risk Score based on factors such

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 02, 2023

as age, obesity, physical inactivity, family history of diabetes, etc. [17] Changes in taste thresholds in type 2 DM if systematically analyzed and documented, may provide an additional diagnostic, screening, and monitoring tool for DM in the future. As seen in this case, altered taste was present only during certain time and not throughout the day. Rather than being an indicator of duration or complications of disease, it could be an indicator of fluctuations in blood sugar levels. Taste disturbances could be a significant pointer to diabetes in at risk patients.

Conclusion

Our study concludes that gustatory impairment for the tastants – sweet, salty, sour, and bitter was observed in obese Type 2 Diabetes mellitus patients having the disease for less than 5 years, though maintaining a fair glycaemic control. This may affect their choices of food items like preference for sweet- tasting food which can exacerbate hyperglycaemia and aggravate obesity. Hypoguesia may also lead to greater intake of salty diet which can escalate the risk of hypertension, renal and heart diseases. Obesity itself is a risk factor for many diseases especially in diabetic individuals and it should not progress further. Knowledge about Hypogeusia in obese diabetics may be used in dietary counseling.

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