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Phenylthiocarbamide Taste Perception among Patients with Type 2 Diabetes Mellitus

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Authors' contributions

This work was carried out in collaboration among all the authors. Author CI designed the study. Authors CI and JMO wrote the protocol. Authors CI and OHO collected samples and did the bench work. Author CI wrote the first draft of the manuscript. Authors CI, JMO and JAO managed the analyses of the study and managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aim: To determine whether Phenylthiocarbamide (PTC) taste blindness is associated with type 2 Diabetes Mellitus (DM) and possible relationship between intake of treatment medications and PTC taste sensitivity.
Methodology: The study participants consisted of 100 type 2 DM patients on treatment (group 1) and 100 newly diagnosed type 2 DM patients not on drugs treatment (group 2). Apparently healthy individuals (100) served as controls (group 3). Informed consent was obtained from each participant at the commencement of the study. Tasters and non-tasters were determined using phenylthiocarbamide (PTC) taste strips (0.0143 mg/strip).
Results: In group 1, 66% were non-tasters; in group 2, 60% were non-tasters while 37% in group 3 were non-tasters. Phenylthiocarbamide taste perception varied significantly among the 3 groups studied ($p < 0.001$). Non-tasters of PTC in groups 1 and 2 were not significantly different ($p = 0.38$).

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Non-tasters of PTC in groups 1 and 2 ($p < 0.001$; OR 3.30 and $p = 0.001$; OR 2.55 respectively) were significantly higher than non-tasters in the control (group 3).
Conclusion: This study shows that inability to taste PTC is associated with type 2 DM. However, intake of DM treatment medications does not appear to have any significant influence on PTC taste sensitivity.

Keywords: Diabetes mellitus; phenylthiocarbamide taste perception; tasters; non-tasters.

1. INTRODUCTION

Diabetes mellitus (DM) is a chronic disorder which poses a major health challenge to humans. About 422 million people were reported to have diabetes globally [1]. It can be classified into 4 types namely; type 1 which is more common in children and adolescents than in adults is an autoimmune disease where the body forms antibodies against its beta cells of islet of Langerhans in the pancreas; type 2 which is associated with adults, characterized by peripheral insulin resistance and inadequate insulin secretion by the pancreas; Secondary DM is caused by another disease or disorder and lastly, gestational DM caused by pregnancy [2,3].

Type 2 DM is reported to make up about 90% of all cases of DM [2,3]. There are reports of higher prevalence of type 2 diabetes in men compared to women which has been associated with sex-related differences in visceral fat mass [4]. The disorder can be asymptomatic in an individual for many months and years.

Taste has influence on one's choice of food. It allows one to choose the food one likes most. Some diseases such as liver diseases, tumour and lifestyle such as consumption of alcohol together with the use of drugs, head trauma, upper respiratory tract infections and exposure to toxic substances have been reported to significantly influence taste [5-7]. It is thought that understanding factors related to taste perception will provide opportunity to evaluate the feeding behaviour of patients with chronic diseases [8].

Phenylthiocarbamide taste sensitivity is correlated strongly with the ability to taste other naturally occurring bitter substances [9,10]. Bitter taste perception occurs through bitter taste receptors located on the surface of taste cells of the tongue [11] and is thought to be a conserved chemical sense in mammals against the ingestion of naturally toxic substances [12]. Taste sensitivity impairment may make an individual to ingest greater quantities of substances which in turn may adversely tamper with the health of the individual. A number of previous studies had been carried out on relationship between diabetes and PTC taste perception. Some of these studies reported positive interactions between inability to taste PTC and DM [13,14]; others reported lack of an association between PTC taste blindness and DM [15].

In Nigeria, PTC taste perception has been studied in relation to some common diseases such as malaria, tuberculosis and HIV infection [16-18]. Type 2 DM is also quite common in Nigeria but to us, there is no known investigation that has related PTC taste perception with DM. Therefore, this study was carried out to determine whether there was any association between type 2 DM and PTC taste perception and to ascertain whether the taste perception was influenced by the intake of DM treatment medications.

2. METHODOLOGY

This study was carried out in Osogbo and Ogbomoso, Southwestern Nigeria. Participants were drawn from patients attending diabetes clinics of Ladoke Akintola University of Technology (LAUTECH) Teaching Hospitals in Osogbo and Ogbomoso, Nigeria. A total of 300 individuals participated in this study. The study participants consisted of 100 type 2 DM patients who had been diagnosed for not less than six months and on metformin treatment (group 1), 100 newly diagnosed type 2 DM patients not on drugs treatment (group 2) and 100 apparently healthy individuals as control (group 3). A sampling of convenience was used and participants were enrolled by picking every other subject that was eligible in each of the three groups. Informed consent was obtained from each participant at the commencement of the study after explaining the essence and procedure of the test. The criteria for diagnosis of DM included fasting blood glucose test: ≥ 126 mg/dl (7.0 mmol/l). Two fasting glucose measurements ≥ 7.0 mmol/l (126 mg/dl) were considered diagnostic for diabetes mellitus. Patients who had other health conditions in addition to diabetes were excluded from the study.

Phenylthiocarbamide taste strips (0.0143 mg of PTC/strip) used was obtained from Carolina Biological Supply Company, North Carolina, USA. Each participant was given a PTC taste strip and a filter paper (as control) and was asked to put each on their tongue and allow to be soaked in their saliva before describing their perception to each strip. Taste description of each participant was recorded. Questionnaire was administered to each participant to obtain relevant information such as age, sex, the drug being received for those on diabetes medication and the like. Data were analysed using percentages. Differences in percentages were tested by Chi-square test. A p-value of < 0.05 was considered to be significant.

3. RESULTS

Results from the study (Table 1) showed that the distribution of the participants across the three groups with respect to age (χ^2 = 0.20, df = 2, p = 0.90) and sex (χ^2 = 0.51, df = 2, p = 0.77) were not statistically significantly different.

In group1 (> 6 months DM patients), 47% were males (15% tasters plus 32% non-tasters) while 53 were females (19% tasters plus 34% non-tasters). Also, of the 100 newly diagnosed diabetic patients (group 2), 45% were males (18% tasters plus 27% non-tasters) and 55% were females (22% tasters plus 33% non-tasters). In addition, of the 100 control subjects, 42 were males (26% tasters plus 16% non-tasters) and 58 were females (37 tasters plus 21 non-tasters). Phenylthiocarbamide taste perception varied significantly among the 3 groups both in males (χ^2 = 8.54, df = 2, p = 0.01) and in females (χ^2 = 10.29, df = 2, p = 0.01). Further Chi-Square tests showed that differences observed in the male groups were between > 6 months DM group and controls (χ^2 = 8.03, df = 1, p = 0.005) and between newly diagnosed DM group and controls (χ^2 = 4.17, df = 1, p = 0.04). Similarly, the differences observed in the female groups were between group 1 and controls (χ^2 = 8.65, df = 1, p = 0.003) and between group 2 and controls (χ^2 = 6.41, df = 1, p = 0.01).

Also, the distributions of the study participants with respect to PTC taste perception are given in Table 1. Sixty-six percent (66%) of the diabetic group of > 6 months were non-tasters, 60% of the newly diagnosed diabetic group were non-tasters while 37% of the control group were non-tasters. Phenylthiocarbamide taste perception varied significantly among the three groups (χ^2 = 18.89, df = 2, p < 0.001). Further Chi-Square tests showed significant differences between the diabetic group on medication and control group (χ^2 = 16.84, df = 1, p < 0.001; OR 3.30, CI 1.86 – 5.85) and between the newly diagnosed diabetic group and control group (χ^2 = 10.59, df = 1, p = 0.001; OR 2.55, CI 1.45 – 4.47). There was no significant difference in taste sensitivity between groups 1 and 2 (χ^2 = 0.77, df = 1, p = 0.38).

4. DISCUSSION

In this study, diabetes patients were more likely to be non-tasters of PTC than non-diabetes individuals. This is in line with the studies of some other researchers who had reported that inability to taste PTC or PTC taste blindness was associated with diabetes mellitus [13,14]. The observation that non-taster status was significantly associated with diabetes in this study could suggest that the gene for PTC might directly or indirectly interact with that of diabetes to confer susceptibility to DM individuals.

Table 1. Distribution of the study participants by age, sex and phenylthiocarbamide taste perception

Variable	DM patients group 1 n=100	DM patients group 2 n=100	Non-DM subjects group 3 n=100	p
Age (years)				0.90
36-45	15	17	18	
46-55	33	35	32	
≥56	52	48	50	
Sex				0.77
Male	47(15T; 32NT)	45(18T; 27NT)	42(26T;16NT)	0.01
Female	53(19T; 34NT)	55(22T; 33NT)	58(37T;21NT)	0.01
PTC Tasting				<0.001
Taster	34	40	63	
Non-Taster	66	60	37	

DM: Diabetes Mellitus T: Taster; NT: Non-taster. Whole figures are in percentages

Polymorphism in TAS2R38 had been linked with differences in ingestive behaviour of tasters and non-tasters which might be associated the development of pre-diabetes and type 2 DM [19].

This study showed that the use of metformin did not influence the association reported since there was no significant difference with respect to taste blindness between the participants on medication and the newly diagnosed diabetic patients. This implied that unlike in HIV infected persons where medication had been reported to alter taste [18,20]; taste alteration induced by medication in diabetes was insignificant.

It had been reported that taste perception appeared to regulate food consumption and had also been linked with circulating metabolic hormones [21]. Bhatia and Sharma [22] reported a decrease in palatability of glucose solution between tasters and non-tasters. Elevated blood glucose levels resulted in a concentration dependent impairment of taste perception in type 2 DM patients due to adaptation of the sensory cell to increased blood glucose [23].

Some researchers observed that the average thresholds to detect sweet taste were higher for diabetic patients compared to non-diabetes showing a decreased or loss of sensitivity in diabetics [24]. This loss of sensitivity might contribute to increase in sugar consumption among diabetics. Loss of taste perception in individuals with type 2 DM had been related to hyposalivation, xerostomia and low salivary flow [25]. Also, it had been reported that higher levels of TNF-alpha, IGF-1 and leptin in tasters than in non-tasters and a positive correlation between plasma glucose level and body mass index in non-tasters [21]. The deficiency or absence of taste interfered with salivation and maturation of the taste buds, causing changes in the perception of taste [26].

5. CONCLUSION

We conclude that PTC taste blindness is significantly associated with type 2 DM and that DM medication has no significant influence on PTC taste sensitivity. Since non-tasters are more likely to have diabetes, identifying and enlightening them early enough can help them to take precautionary measures against coming down with the disease condition.

CONSENT

Informed consent was obtained from each participant at the commencement of the study.

ETHICAL APPROVAL

Ethical approval for this study (Pro/2015/008) was obtained from the Ethical Committee of the College of Health Sciences, Ladoke Akintola University of Technology (LAUTECH), Osogbo.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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