

Phenylthiocarbamide Taste Perception among Patients with Type 2 Diabetes Mellitus

Original Research Paper

ABSTRACT

Aim: To determine the Phenylthiocarbamide PTC taste blindness which 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 served as control (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; 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 ($p = 0.38$). 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].

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

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

34 Phenylthiocarbamide taste sensitivity is correlated strongly with the ability to taste other
35 naturally occurring bitter substances [9, 10]. Bitter taste perception occurs through bitter
36 taste receptors located on the surface of taste cells of the tongue [11] and is thought to be a
37 conserved chemical sense in mammals against the ingestion of naturally toxic substances
38 [12]. Taste sensitivity impairment may make an individual to ingest greater quantities of
39 substances which in turn may adversely tamper with the health of the individual. A number of
40 previous studies had been carried out on relationship between diabetes and PTC taste
41 perception. Some of these studies reported positive interactions between inability to taste
42 PTC and DM [13, 14]; others reported lack of an association between PTC taste blindness
43 and DM [15].

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

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51 **2. METHODOLOGY**

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53 This study was carried out in Osogbo and Ogbomoso, Southwestern Nigeria. Participants
54 were drawn from patients attending diabetes clinics of Ladoko Akintola University of
55 Technology (LAUTECH) Teaching Hospitals in Osogbo and Ogbomoso, Nigeria. A total of
56 300 individuals participated in this study. The study participants consisted of 100 type 2 DM
57 patients who had been diagnosed for not less than six months and on metformin treatment
58 (group 1), 100 newly diagnosed type 2 DM patients not on drugs treatment (group 2) and
59 100 apparently healthy individuals as control (group 3). A sampling of convenience was used
60 and participants were enrolled by picking every other subject that was eligible in each of the
61 three groups. Informed consent was obtained from each participant at the commencement of
62 the study after explaining the essence and procedure of the test. The criteria for diagnosis of
63 DM included fasting blood glucose test: ≥ 126 mg/dl (7.0 mmol/l). Two fasting glucose
64 measurements ≥ 7.0 mmol/l (126 mg/dl) were considered diagnostic for diabetes mellitus.
65 Patients who had other health conditions in addition to diabetes were excluded from the
66 study. Ethical approval for this study (Pro/2015/009) was obtained from the Ethical
67 Committee of the College of Health Sciences, Ladoko Akintola University of Technology
68 (LAUTECH), Osogbo.

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

77 **3. RESULTS**

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79 Results from the study (Table1) showed that the distribution of the participants across the
80 three groups with respect to age ($\chi^2 = 0.20$, $df = 2$, $p = 0.90$) and sex ($\chi^2 = 0.51$, $df = 2$, $p =$
81 0.77) were not statistically significantly different.

82 In group1 (> 6 months DM patients), 47% were males (15% tasters plus 32% non-tasters)
83 while 53 were females (19% tasters plus 34% non-tasters). Also, of the 100 newly diagnosed
84 diabetic patients (group 2), 45% were males (18% tasters plus 27% non-tasters) and 55%
85 were females (22% tasters plus 33% non-tasters). In addition, of the 100 control subjects,
86 42 were males (26% tasters plus 16% non-tasters) and 58 were females (37 tasters plus 21
87 non-tasters). Phenylthiocarbamide taste perception varied significantly among the 3 groups
88 both in males ($\chi^2 = 8.54$, $df = 2$, $p = 0.01$) and in females ($\chi^2 = 10.29$, $df = 2$, $p = 0.01$).
89 Further Chi-Square tests showed that differences observed in the male groups were
90 between > 6 months DM group and controls ($\chi^2 = 8.03$, $df = 1$, $p = 0.005$) and between
91 newly diagnosed DM group and controls ($\chi^2 = 4.17$, $df = 1$, $p = 0.04$). Similarly, the
92 differences observed in the female groups were between group 1 and controls ($\chi^2 = 8.65$, df
93 $= 1$, $p = 0.003$) and between group 2 and controls ($\chi^2 = 6.41$, $df = 1$, $p = 0.01$).

94 Also, the distributions of the study participants with respect to PTC taste perception are
95 given in Table 1. Sixty-six percent (66%) of the diabetic group of > 6 months were non-
96 tasters, 60% of the newly diagnosed diabetic group were non-tasters while 37% of the
97 control group were non-tasters. Phenylthiocarbamide taste perception varied significantly
98 among the three groups ($\chi^2 = 18.89$, $df = 2$, $p < 0.001$). Further Chi-Square tests showed
99 significant differences between the diabetic group on medication and control group ($\chi^2 =$
100 16.84 , $df = 1$, $p < 0.001$; OR 3.30, CI 1.86 – 5.85) and between the newly diagnosed diabetic
101 group and control group ($\chi^2 = 10.59$, $df = 1$, $p = 0.001$; OR 2.55, CI 1.45 – 4.47). There was
102 no significant difference in taste sensitivity between groups 1 and 2 ($\chi^2 = 0.77$, $df = 1$, $p =$
103 0.38).

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105 **Table 1: Distribution of the Study Participants by Age, Sex and Phenylthiocarbamide**
 106 **Taste Perception**
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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	

108 DM: Diabetes Mellitus T: Taster; NT: Non-taster. Whole figures are in percentages
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112 **4. DISCUSSION**

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114 In this study, diabetes patients were more likely to be non-tasters of PTC than non-diabetes

115 individuals. This is in line with the studies of some other researchers who had reported that

116 inability to taste PTC or PTC taste blindness was associated with diabetes mellitus [13, 14].

117 The observation that non-taster status was significantly associated with diabetes in this

118 study could suggest that the gene for PTC might directly or indirectly interact with that of

119 diabetes to confer susceptibility to DM individuals. Polymorphism in TAS2R38 had been

120 linked with differences in ingestive behaviour of tasters and non-tasters which might be

121 associated the development of pre-diabetes and type 2 DM [19].

122 This study showed that the use of metformin did not influence the association reported since

123 there was no significant difference with respect to taste blindness between the participants

124 on medication and the newly diagnosed diabetic patients. This implied that unlike in HIV

125 infected persons where medication had been reported to alter taste [18, 20]; taste alteration
126 induced by medication in diabetes was insignificant.

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

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

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143 **4. CONCLUSION**

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

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150 **Ethical:**

151 Ethical approval for this study (Pro/2015/009) was obtained from the Ethical Committee of
152 the College of Health Sciences, Ladoke Akintola University of Technology (LAUTECH),
153 Osogbo.

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155 **Consent:**

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

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159 **COMPETING INTERESTS**

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161 Authors have declared that no competing interests exist.

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