

Sweet Taste Threshold among Medical Students with Family History of Diabetes Mellitus

Nasya Aisah Latif,¹ Yulia Sofiatin,² Maya Kusumawati,³ Rully M.A. Roesli,³

¹Faculty of Medicine Universitas Padjadjaran, Indonesia ²Department of Public Health Faculty of Medicine Universitas Padjadjaran, Indonesia, ³Department of Internal Medicine Faculty of Medicine Universitas Padjadjaran/Dr. Hasan Sadikin General Hospital, Bandung, Indonesia

Abstract

Background: Diabetic patients have low sensitivity towards sweet taste, thus consuming more sugar. A young adult with family history of diabetes mellitus (FHD) who lives with diabetic parents may have an increased risk of overconsumption of sugar due to a similar dietary pattern, leading to diabetes. This study aimed to explore the difference in the sweet taste threshold (STT) between students with and without a family history of diabetes mellitus.

Methods: This cross-sectional study was conducted in October–November 2018 on Class 2018 medical students living in a student dormitory who were divided into those with family history of diabetes (FHD) and those without it (non-FHD). Family history of diabetes and other known diseases were self-reported. The three-Ascending Forced Choice method was used to determine the sweet recognition threshold. Mann-Whitney analysis was used to compare the sweet taste thresholds between the two groups.

Results: A total of 183 subjects participated in this study. The non-FHD group had a higher rank of sweet taste threshold than subjects in the FHD group (94.21 vs 81.16), albeit insignificant ($p=0.192$). Interestingly, the modes of best estimation threshold (BET) for non-FHD group was than the FHD group (0.067 M vs 0.043 M).

Conclusions: The BET for students without family history of diabetes is higher than those with family history of diabetes. It is imperative that low sugar consumption campaign should also aim young people without FHD.

Keywords: Diabetes, medical student, sweet taste threshold, sugar campaign

Introduction

Diabetes is an irreversible disease characterized by hyperglycaemia. In 2013, 6.9% of the population in Indonesia were diabetes, and this number is increased by 1.6% in 2018.¹ About 10.7% of global mortality is caused by diabetes.² Economical burden caused by this disease worldwide is estimated to reach 727 million USD.²

One of the unmodifiable risk factors for diabetes is family history. Children who have parents with diabetes, known as a family history of diabetes (FHD) have an increased risk of diabetes 2–4 times higher than non-diabetic parents.^{2,3} Individual with diabetes show higher insulin resistance.⁴ The

modifiable risk factor includes lifestyles such as dietary habits.² The whole family would share the similar dietary and physical patterns, for example, children would adopt the pattern of their parents and thus put the children at a higher risk of developing diabetes by 29%.⁵ Overconsumption of sugar shows a positive association with the development of diabetes mellitus. Studies have shown that Indonesian adults with FHD have consumed more sugar than the World Health Organization (WHO) recommendation, even though they know they are facing a high risk of developing diabetes.^{6,7} In young adults, taste plays an important role in dietary choice.⁸ In order to taste a certain taste and interpret it correctly, a minimum concentration is required, known

Correspondence: Nasya Aisah Latif, Faculty of Medicine Universitas Padjadjaran, Jalan Raya Bandung Sumedang Km. 21 Jatinangor, Sumedang Indonesia. E-mail: nasya16001@mail.unpad.ac.id

as recognition threshold.⁹ Diabetic patients show a low taste sensitivity, leading to a higher taste threshold.¹⁰ Higher sweet taste threshold (STT) means that a higher sugar concentration is needed.

Medical students are assumed to be more aware of health problems, including the knowledge of their family's health problem and their lifestyle. As a specific group of young adults, the first-year medical students have been chosen to minimize the role of the new environment toward their taste threshold. This study aimed to analyze the difference in sweet taste threshold between medical students with or without FHD. The result is expected to be adopted into a diabetes prevention program.

Methods

A cross-sectional study was conducted in October–November 2018 at the student's dormitory hall of Bale Wilasa Universitas Padjadjaran to minimize distraction and to keep the room test odour free, since the taste was known to be affected by odour. The protocol of this study was approved by the Research Ethics Committee Universitas Padjadjaran (No: 1311/UN6.KEP/EC/2018)

All medical students in Universitas Padjadjaran batch 2018 filled an online form that contained informed consent, demographic data, and questions about inclusion and exclusion criteria. The eligibility requirement for this study was individuals in a healthy state. Students with a known medical conditions, such as diabetes mellitus, hypertension, stroke, cancer, chemotherapy, radiotherapy, and having a cold or flu on the day of a test or any behaviours that might influence taste sensitivity, such as smoking and alcohol addiction were excluded. FHD was self-reported.

A day prior to the sweet taste threshold examination, all eligible subjects were informed not to drink, eat, or brush their teeth 1 hour before the test. Three-Ascending Forced Choice (3-AFC) methods was used to determine the recognition threshold.⁹ This procedure forced the subject to choose between a set of 3 solutions, 2 blank samples, and 1 target sample. There were 8 sets of test samples, each set was separated by a tray in an ascending concentration order from left to right. Each solution sample was labelled by 3 random digit numbers. The order of blanks and sample was randomized for each set.

The sugar solution was made from dextrose monohydrate and commercially distilled water.

The amount of dextrose was weighed using an analytical balance. Solution concentrations were determined based on a previous pilot study of 25 individuals from the population. 0.00004 M, 0.0002 M, 0.001 M, 0.005 M, 0.025 M, 0.125 M, 0.625 M, and 3.125 M was the concentration used for the pilot test. The lowest and highest result from the pilot test were used to make the concentration range for the actual test (0.002 M, 0.006 M, 0.018 M, 0.054 M, 0.162 M, 0.486 M, 1.458 M, and 4.374 M).

Each subject was given an adequate explanation of the procedure. They were asked to rinse their mouth with distilled water before starting each set to neutralize their mouth. Next, subjects were asked to taste the sample from left to right with the sip-and-spit technique. After one set of concentration, they were asked to choose and record which solution has a different taste and identify the taste they felt. The tasting procedure was done once.

The sweet taste threshold (STT) of the students was determined by using the individual best estimation threshold (BET), which was a geometric mean of 2 concentrations; the first concentration was the first of the subsequent correct answer; the second concentration was the least wrong answer. The analysis was conducted based on FHD. Group BET was used to compare the STT using the Mann-Whitney test. Statistical analysis was conducted using IBM® SPSS Statistics Version 23 for Windows. All Statistical tests was performed using a level significance of <0.05

Results

One hundred and ninety-three out of two hundred and seventy-four medical students of Universitas Padjadjaran were agreed to participate in the test, but only 183 subjects carried out the test after excluded due to illness on the day of the test or dropped out. They were then grouped based on their FHD. The characteristic of the students showed that gender and body mass index (BMI) were not significantly different between the two groups (Table 1).

The best estimation threshold (BET) of the majority of students without FHD was 0.090 M while in those with FHD was 0.030 M, however, there was no significant difference between the two groups ($p=0.192$; Mann Whitney test). Furthermore, the mean rank of STT for each group was compared, resulting in higher ranks among students without FHD than those with FHD which was 94.21 vs 81.16, respectively.

Table 1 Baseline Characteristics of Medical Students Based on Family History of Diabetes

		Parental Diabetes				p-value
		No (n=152)		Yes (n=31)		
		n	%	n	%	
Gender	Male	47	30.9	12	38.7	0.406
	Female	105	69.1	19	61.3	
BMI (kg/m ²)	Underweight (<18.5 kg/m ²)	22	14.5	4	12.9	0.323
	Normal Weight (18.5–22.9 kg/m ²)	82	53.9	14	45.2	
	Overweight (23–24.9 kg/m ²)	20	13.2	5	16.1	
	Obese (\geq 25 kg/m ²)	28	18.4	8	25.8	

The BET in students without a family history of diabetes was higher than students with a family history of diabetes, which was 0.067 M vs 0.043 M, respectively.

Discussion

The taste sensitivity can be affected by gender,¹¹ BMI,¹² age,¹¹ smoking,¹³ and alcohol consumption.¹⁴ In our study, there are no significant differences in age and BMI between students with a family history of diabetes (FHD) and those without. In this study, we do not analyze smoking habits and alcohol consumption, since these factors have been excluded in the beginning.

There are students (n17) in the group without FHD that falsely identify the sweet taste for bitter or sour. Other students (n3) have marked the wrong check box on the paper at the 7th and 8th set of the test. These false responses can be caused by sensory adaptation; after tasting several similar stimuli, the subject may be partially adapted to the samples therefore when presented with higher stimuli and it may be perceived as weaker concentration than before, thus they responded with an incorrect answers.⁹ Some students (n7) already identify the sweet taste at the lower concentration, but the response has changed to “sour” or “bitter” at the higher concentration (6th or 7th concentration). Other students (n6) can only identify sweet taste on the seventh or eighth concentration, and one student could not identify the sweet taste at all. These students might have taste receptor

abnormalities.

The sweet taste threshold (STT) of the students without FHD in this study is higher than the STT of those with FHD, but not significantly differs. This result is in contrary to previous studies in Chicago.¹⁵ Similar to our study, the study in Jakarta⁷ also showed no statistical significance ($p=0.137$). The different results from this study can be caused by several factors. First, increasing awareness for the past thirty years could change people's behaviour. In the 1970s there was no adequate prevention campaigns for diabetes.¹⁶ The Second National Health & Nutrition Exam Survey (NHANES II) showed that only half of the people with diabetes knew they had the disease.¹⁶ In 1977, the Centres for Disease Control (CDC) started to fund projects in the United States to reduce diabetes mortality and morbidity through secondary and tertiary prevention.¹⁶ It explained the higher sweet taste threshold among respondents with FHD in the 1970s. The role of up bringing in diet pattern was very strong.

A study in 2018 showed that people with FHD were more aware of the disease compared to those without FHD.¹⁷ There was also a positive association between family history of diabetes with a healthier diet and regular exercise.¹⁸ A consistent reduced sugar intake can increase taste sensitivity. A study with 13 subjects that tried a three-month low-sugar diet can perceived sucrose to be significantly sweeter.¹⁹ It explained the lesser difference in STT between respondents with and without FHD.

Table 2 Distribution of Sweet Taste Threshold

		Parental Diabetes				Total	
		No (n=152)		Yes (n=31)		n	%
		n	%	n	%		
	0.00037	1	0.7	-	-	1	0.5
	0.003	3	2.0	-	-	3	1.6
	0.010	24	15.8	5	16.1	29	15.8
	0.030	39	25.7	13	41.9	52	28.4
BET (M)	0.090	59	38.8	11	35.5	70	38.3
	0.280	9	5.9	2	6.5	11	6.0
	0.841	6	3.9	-	-	6	3.9
	2.525	6	3.9	-	-	6	3.9
	7.576	5	3.3	-	-	5	3.3
	P-value	0.192					

Note: BET= best estimation threshold, M= molar (mol/l), P-value was obtained using Mann Whitney statistical test

The medical student is a special population. By choosing medicine as the future profession they have higher attention toward health and disease prevention. Many students choose to study medicine because of personal or family experience. Their exposure to the illness of family member might play an important role in deciding to follow a healthier lifestyle, including eating less sugar which leads to a lower sweet taste threshold. STT among medical students without FHD are varied. It could be caused by unawareness of parental diabetic status, leading to misclassification.

A study in India⁵ showed that families who lived together tend to have a similar dietary habits. Those who are raised by undiagnosed parents are assumed to be living with a high sugar intake for a long period can lower the STT. This may reduce the sensitivity, caused by the ability of sense of taste to adapt.⁹

There are limitations to this study. Despite clear instruction not to communicate with other respondents, the room setting used for multiple subjects at the same time due to limited time, resources, and space may not ideally be followed. Family history of diabetes in this study is self-reported which could lead to misreporting. There is a possibility that the respondent might not know their parents' status of diabetes. A limited number

of Indonesians have their blood glucose checked, and around 73.7% of diabetic patients are undiagnosed.² It is estimated that type 2 diabetes may arise 4 to 6 years before the clinical diagnosis.²⁰ The proportion of respondents with a family history of diabetes among the study population is 19.6%, higher than the reported prevalence (8.5%).

In conclusion, our study has shown that the group BET for sweet taste in medical students without a family history of diabetes is higher than those with family history, although the difference is not statistically significant. It suggests that a low sugar diet campaign should also aim at those without a family history of diabetes. Further study on young adults other than medical students will strengthen the importance of this study.

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