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Original Article

Relationship between taste sensitivity and dental caries

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Abstract

Dental caries is still one of the most common diseases to afflict mankind. It affects 34.1% of the global population. Some studies have reported that individuals with high sugar intake have higher dental caries rates. However, the physiological mechanisms underlying an individual's craving for sweet substances were not well documented. It was also reported that taste sensitivity may be associated with the preference for or rejection of some foods. Sweet preference has been linked to bitter taste sensitivity to 6-*n*-propylthiouracil (PROP). The PROP impregnated paper strip is proved to be a useful tool in determining the inherent sensitivity levels (super-taster, medium-taster, and non-taster) to bitter and sweet tastes. The purpose of this study is to evaluate the relationship between taste sensitivity to PROP and dental caries. The results showed a significantly larger number of untreated dental caries lesions among non-tasters compared to super-tasters. However, there was no statistically significant difference in the DMFT index value among the three groups. These results suggest that taste sensitivity to PROP could be a useful screening tool to identify individuals with high dental caries risk.

Key Words: dental caries, taste perception, taste sensation, PROP(6-n-propylthiouracil)

Introduction

Dental caries is still one of the most common diseases to afflict mankind. Recent data confirmed that untreated dental caries is the most common global health condition and it affects 34.1 % of the global population[1]. However, because it has a multifactorial etiology, an absolute assessment method for dental caries risk has not been established yet[2].

To date, many attempts have been made to identify high-risk individuals for dental caries. Many reports indicated that a child's preference for sugar, and the resulting high sugar intake, may lead to increased dental caries rates[3-9]. However, the physiological mechanisms underlying an individual's craving for sweet substances were not well documented.

It has been reported that taste sensitivity may be associated with the preference for or rejection of some foods[10]. Individuals can be classified as super-tasters, medium-tasters and non-tasters based on their taste sensitivity threshold. Super-tasters and medium-tasters

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have less preference for food with stronger tastes than non-tasters[11].

Sweet preference has been linked to bitter taste sensitivity to 6-*n*-propylthiouracil (PROP) [12-14]. PROP is a pharmacological drug for Grave's disease treatment. PROP tastes bitter to tasters, but it is tasteless to non-tasters[12]. Some studies in taste psychophysics have distinguished between non-tasters, medium-tasters, and super-tasters based on PROP detection thresholds[15,16]. Sensitivity to the bitter taste of PROP is an inherited trait[12,17], which is mediated by the TAS2R38 gene[18,19]. It has been reported that PROP tasters are more likely to dislike sweet taste, whereas almost all non-tasters prefer sweet flavors[15], because PROP tasters are more sensitive to sweetness[20]. They perceive lower concentrations of sugars and tend to dislike intensely sweet foods[16].

Due to this influence on food preference, sensitivity to PROP has been linked to dental caries. A study reported that the overall dental caries status (mean DMFT/dmft index value) was significantly larger for non-tasters compared to super-tasters[7]. This could be due to overall increase in consumption of sugar rich foods by non-tasters[5,6].

PROP impregnated paper strip is proved to be a useful tool in determining the inherent sensitivity levels to bitter and sweet taste[5,7,21]. For the reasons above, we hypothesized that taste sensitivity to PROP may be a useful screening tool to identify individuals with high dental caries risk.

However, the proportion of tasters and non-tasters might vary in different populations and, hence, population-specific studies are required[22]. To our knowledge, such kind of research has not been performed in Japan. Therefore, the purpose of this study is to evaluate the relationship between taste sensitivity to PROP and dental caries in order to identify individuals at higher risk of developing dental caries in Japan.

Materials and Methods

Source of data

A total number of 61 individuals belonging to the age group of 19 to 91 year-old of both sexes were recruited from Chiba Prefectural University of Health Sciences Dental Clinic. (Table 1).

Table1. Characteristics of the study population

	Super-taster	Medium-taster	Non-taster
Age, mean±SD	46.88 ± 17.41	56.86 ± 19.82	67.00 ± 23.72
Sex, n			
Male	1	6	17
Female	7	22	8
Maximum DMFT index value	24	28	28
Minimum DMFT index value	3	0	5
Maximum untreated dental caries, n	0	3	16
Minimum untreated dental caries, n	0	0	0

Preparation of the PROP strips

The pure sample of PROP was obtained from the pharmaceuticals (Takeda Pharmaceutical Co. Ltd., Osaka, Japan) and the PROP strips were prepared in the Department of Dental Hygiene, Chiba Prefectural University of Health Sciences. Whatman filter paper (GE Healthcare UK. Ltd., Buckinghamshire, UK) was cut into 2 × 2 cm size and sterilized in an autoclave (SUPERCLAVE HF260, HIRAYAMA Manufacturing Co. Ltd., Saitama, Japan) at 121°C for 15 minutes. PROP (10 mg/ml) was dissolved in 5 ml of ethyl alcohol in a beaker. Ten previously cut and sterilized Whatman filter paper strips were soaked in the above solution for one hour for the complete absorption of the drug. The strips were removed and were allowed to dry at room temperature. The average amount of the drug impregnated on each strip was approximately 1.6 mg[3,5,7].

PROP sensitivity test

The PROP sensitivity test was carried out by placing the PROP impregnated paper strips on the dorsal surface of the subject's tongue for 30 seconds to determine the taste sensitivity to bitter and sweet substances. After tasting the paper, they were asked "Do you taste anything?" If their response was no, they were classified as non-tasters. If they responded that it tasted bitter or very bitter, they were classified as medium- or super-tasters, respectively. Consequently, they were classified into the three groups according to the intensity of bitterness they felt.

Clinical examination

A single trained and calibrated examiner performed a comprehensive clinical examination with the assistance of one recorder. All teeth were examined using visible light, mouth mirror, and CPI probe. Then, the number of decayed, missing and filled teeth (DMFT index value) was recorded using the World Health Organization

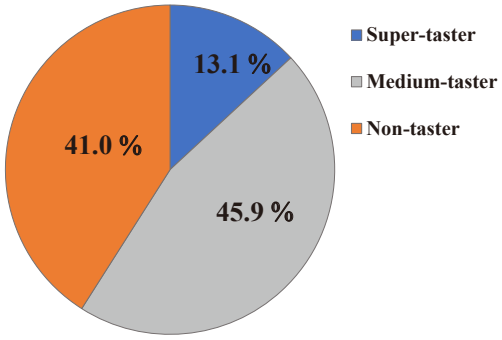

Figure 1. Taster status of the participants based on PROP test

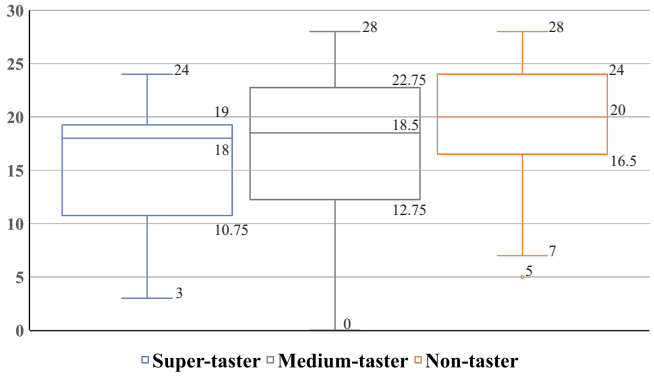

Figure 2. DMFT index value

There was no statistically significant differences in the DMFT index values among the three groups.

criteria for caries assessment[23]. The obtained results were subjected to statistical analysis. The analysis was performed by Steel-Dwass test ($p < 0.05$) using JMP Pro software version 14 (SAS Institute Inc., Cary, NC, USA).

Ethical clearance

This proposed study was reviewed by the ethical committee of Chiba Prefectural University of Health Sciences, Chiba, Japan and clearance (No. 2018-11) was obtained. And informed consents were obtained from all the substantial individuals.

Results

Of the total 61 individuals, 8 (13.1 %) were super-tasters, 28 (45.9 %) were medium-tasters, and 25 (41.0 %) were non-tasters (Fig. 1).

The minimum number ~ median ~ maximum number of untreated dental caries lesion was 0~0~0 for super-tasters, 0~1~3 for medium-tasters, and 0~1~16 for non-tasters. Of the super-taster group, no individual had untreated dental caries. On the other hand, 8 out of 28 medium-tasters and 11 out of 25 non-tasters had untreated dental caries. The number of untreated dental caries lesion was significantly larger for non-tasters than super-tasters ($p = 0.037$) (Table. 1).

Super-tasters had a DMFT index value of 3~18~24, medium-tasters 0~18.5~28, and non-tasters 5~20~28. However, there was no statistically significant difference in the DMFT index values among the three groups ($p > 0.05$) (Fig. 2).

The highest DMFT index value in the super-taster group was 24, but it was as high as the 28 observed in both medium and non-taster groups.

Discussion

This study was conducted to investigate whether the sensitivity to bitter taste of 6-n-propylthiouracil (PROP) could be used to identify individuals at higher risk of developing dental caries in Japan.

The ability to taste PROP is an inherited trait. Super-tasters are able to perceive tastes in lower concentration of bitter or sweet substance than non-tasters. Anatomically, super-tasters have a higher density of fungiform papillae and taste receptors on the anterior portion of the tongue than medium-tasters and non-tasters[24-28]. Hence, tasters might avoid intensely sweet foods and beverages because their oral sensations are too intense and, thus, it is less pleasant to accept their taste. This makes them less prone to tooth decay[19].

On the other hand, non-tasters may not be able to perceive sweet or bitter tastes in the same concentration as super-tasters. Hence, they require a higher concentration to perceive taste in the food products[19,29]. Non-tasters may, therefore, have higher concentrations and frequencies of sugar intake compared to super- or medium-tasters. Consequently, they are more susceptible to dental caries[11,19].

In this study, a total of 13.1 % of the individuals were found to be super-tasters and 41.0 % were found to be non-tasters. It agrees with other studies that found more non-tasters than super-tasters in the caries-active group[1,19]. Of the non-taster group, one individual had 16 and two individuals had 11 untreated dental caries lesions. Interestingly, no individuals had untreated dental caries in the super-taster group.

Overall, there was a tendency of increasing number of dental caries lesions as the taste sensitivity to PROP decreased. These results suggest that taste sensitivity

to PROP could be a useful screening tool to identify individuals at higher risk of developing dental caries in similar populations.

Conflicts of Interest

The authors have no conflicts of interest directly relevant to the content of this article.

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