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**Krithi N**  
Private Practitioner, Aasaya  
Centre for Dentistry, Bangalore,  
Karnataka, India

**Puja Yavagal**  
Professor, Department of Public  
Health Dentistry, Bapuji Dental  
College and Hospital,  
Davanagere, Karnataka, India

**Nagesh L**  
Professor and Head, Department  
of Public Health Dentistry,  
Dayanand Sagar College of  
Dental Sciences, Bangalore,  
Karnataka, India

**Corresponding Author:**  
**Puja Yavagal**  
Professor, Department of Public  
Health Dentistry, Bapuji Dental  
College and Hospital,  
Davanagere, Karnataka, India

## Dental caries experience among school children with different genetic sensitivity to bitter taste of 6-n-propylthiouracil: A cross-sectional survey

**Krithi N, Puja Yavagal and Nagesh L**

### Abstract

**Background:** Genetic sensitivity to bitter taste perception may influence their consumption of refined sugars which in turn has implication on the causation of dental caries.

**Aim:** To assess and compare the dental caries experience among children with different genetic sensitivity to bitter taste of 6-n-propylthiouracil.

**Methodology:** A cross sectional survey was conducted among 150 children of Davanagere city. Data regarding Sociodemographic details, dietary preferences, oral hygiene practices, Oral hygiene status, caries experience and taste perception to 6-N Propyl thiouracil were recorded. Data was analyzed using Kruskal Wallis Analysis of Variance, chi square test and Ordinal regression analysis. Significance level was set at  $p < 0.05$

**Results:** Caries experience was significantly higher ( $p < 0.05$ ) among non-tasters compared to supertasters and medium tasters. Ordinal regression analysis revealed no significant association ( $p > 0.05$ ) between caries risk of an individual and taste perception.

**Conclusion:** The caries experience among supertasters was low.

**Keywords:** Taste perception, PROP test, Dental caries

### 1. Introduction

Dental caries is a major oral health problem across various countries. The prevalence of dental caries in India is 31.5-89% which indicates it to be a major public health problem posing a great challenge to dental professionals [1]. There is overwhelming evidence to support association between sugar consumption and dental caries. Earlier studies stated that the amount and frequency of sugar intake were influenced by the life style of the people but according to recent research it's due to individual genetic differences in sensitivity to taste perception [2]. Taste worlds of humans vary because of taste blindness to 6-n-propylthiouracil [PROP]. Sensitivity to PROP is inherited [3]. PROP is a medication used in the treatment of Grave's disease. PROP can be tasted at very low concentration of 1.6mg. PROP is safe to use in both children and adults to assess the genetic sensitivity to bitter taste [4]. The subset of the population who rate PROP paper as intensely bitter are identified as supertasters. Supertasters generally perceive taste at lower concentration as compared to medium and non-tasters and thus generally show ambivalence to foods with high concentration of these taste qualities, where as non-tasters tend to prefer them. This may influence their consumption of refined sugars which in turn has implication on the causation of dental caries. Determining caries risk factors is very important before planning preventive programs. Caries activity tests play a pivotal role in assessing the caries risk of the patients. Although caries activity tests are more detailed and give reliable results, majority of the tests are cumbersome, expensive and time consuming. On the other hand, PROP test is easily applicable, quick, less expensive and safe. Few studies have stated a significant negative relationship between PROP sensitivity and caries experience [5] However there is relative paucity of studies in this regard. The research question of the study was "Is there a difference in dental caries experience among 15year old school students with different genetic sensitivity to bitter taste of 6-n-propylthiouracil?" which aimed at assessing and comparing the dental caries experience among school children with different genetic sensitivity to bitter taste of 6-n-propylthiouracil.

## 2. Methodology

Study design was a descriptive, cross sectional survey. Permission to conduct the study was obtained from Ethical approval was obtained from the institutional review board of Bapuji Dental College and Hospital, Davanagere. A self-designed format concerned authorities. proforma containing four sections was used to record relevant data pertaining to study like demographic details, oral hygiene practices, dietary habits, assessment of Oral hygiene status (Oral Hygiene Index Simplified (OHIS) given by John C. Green and Jack R. Vermillion, 1964) [6], Dental caries experience (Decayed, Missing and Filled Tooth Index (DMFT) with modified criteria given by WHO in 1997 [7], PROP test results (PROP test) [5]. Sample size of 50 per group (total 150 subjects) was scientifically determined wherein pooled standard deviation of 2.6 and minimum expected difference of 1.2 DMFT was obtained from the previous study done by Oter *et al.* [2]. Multistage sampling technique was employed to select the study subjects. Davanagere city was arbitrarily divided into four zones. From each zone, one school was selected randomly and from each school, students aged 15 years who fulfilled the selection criteria were randomly selected. Quota sampling technique was employed to obtain a minimum of 50 subjects in each group. Eligibility criteria for selection of study subjects were 15 year old school students studying in Davanagere city, whose guardians provided consent for their participation. Subjects suffering from systemic diseases or/ on long term/recent/current regimen of medication that affected taste perception, known allergy/ history of adverse reactions to propylthiouracil, acute dental distress, requiring emergency dental treatment, undergoing orthodontic treatment were excluded. All the examinations were carried out by a single examiner who was calibrated (kappa value of 0.88 and 0.78 with respect to DMFT index and OHIS index respectively). Voluntary written informed consent from the guardians and assent from the study participants were obtained. For oral examination the subjects were made to sit comfortably on a chair with back rest and examined under natural lighting condition near the school premises.

### 2.1 PROP test

#### 2.1a Preparation of the PROP strips [8].

Pure samples of PROP powder were obtained from Sigma Aldrich Company, Dharwad, India. Sterile PROP strips containing 6-n-propylthiouracil were prepared at Bapuji Institute of Pharmacy College, Davanagere. Whatman filter paper was cut into 2 × 2 cm size and sterilized in an autoclave at 121°C for 15 minutes. The sterilized strips were weighed and stored in the desiccator until they were used for further preparation. 6-n-propylthiouracil (10 mg/ml) was dissolved in 5 ml of 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 allowed to dry at room temperature. Approximately 1.6 mg of drug was impregnated on each strip.

#### 2.1b PROP test procedure [9].

The PROP strips were placed on the dorsal surface of the anterior two-third's region of the tongue for 30 seconds. The children were given general Labelled Magnitude Scale (gLMS) which is a semantic scale of perceptual intensity characterized by a quasi-logarithmic spacing. Verbal instructions on how to rate the intensity of a variety of sensations using the general Labelled Magnitude Scale

(gLMS) was given to participants by the examiner. They were shown a lined scale with numbers ranging from 0 to 100 on one side and descriptive adjectives on the other side (0 = no sensation, 100 = strongest imaginable). After tasting PROP filter paper, depending upon the taste they experienced, they were asked to rate the intensity on the labelled magnitude scale called Green's scale [10, 11]. Based on their ability to rate the intensity of bitter taste on a modified labelled magnitude scale (LMS) these children were subdivided into three groups as PROP super tasters (intensity rate > 60), PROP medium tasters (intensity rate 12-60) and PROP non-tasters (intensity rate < 12).

### 3. Statistical Analysis

Statistical analyses were performed using PASW 19 version, USA. Nature of the data was checked using Kolmogorov-Smirnov test and Shapiro-Wilk test and it was found that data was not normally distributed hence non parametric statistics were used. Categorical data were compared using chi square test. Kruskal Wallis Analysis of Variance was used to compare the medians between three groups followed by Post hoc Mann Whitney U test where significant association was observed. Ordinal regression analysis was applied to find the association between caries experience and independent variables [Socioeconomic status, gender, sweet 30.41 consumption, snacking habits, soft beverages consumption and taste perception]

### 4. Results

Mean DMFT of study population was 2.69±2.19. Mean number of teeth per child was 27.97 ±0.32 and mean taste perception as assessed by 100 point Labelled Magnitude Scale (LMS) was 41.17± 30.41. Among females, majority of them were medium tasters, whereas majority of male subjects were non tasters. (Table 1) Distribution of the study subjects based on dietary habits among different taster groups revealed no association between taste perceptions and liking for sweets (chi square value= 1.506, p=0.471). Majority of the supertasters and medium tasters had a liking for sweets. In contrast more than 50% of the non-tasters had no liking for sweets. A significant association was found between taste perception and frequency of sweet consumption (chi square value=16.44, p< 0.001). Frequency of sugar consumption, snacking habits and soft beverages consumption were significantly more among non-tasters compared to medium and supertasters. (Table 2) Distribution of the study subjects based on caries risk (categorized according to Decayed Missing Filled Teeth scores) among different taster groups depicted a statistically significant association between caries risk groups (categorized according to Decayed Missing Filled Teeth scores) and taste groups (Chi square value=32.782, p< 0.001). Majority of the supertasters had low caries risk. Among medium tasters and non-tasters, majority had high caries risk. (Table 3). The median DMFT scores of supertasters were less compared to median DMFT scores of medium tasters and non-tasters in the present study which was statistically significant. (Table 3)

**Table 1:** Gender wise distribution of the study subjects based on taste perception.

SEX	Supertasters		Medium tasters		Non tasters	
	N	%	N	%	N	%
Females	25	37.9	29	44	12	18.1
Males	25	29.8	21	25	38	45.2

**Table 2:** Distribution of the study subjects based on dietary habits

Dietary habits	Response	Super tasters		Medium tasters		Non tasters		Chi-square value	Probability value
		N	%	N	%	N	%		
Liking for sweet	yes	28	46	30	60	24	48	1.506	0.471
	no	22	44	20	40	26	52		
Frequency of sweet consumption	Thrice or less	49	98	48	96	38	76	16.44	<0.001**
	More than thrice a week	1	2	2	4	12	24		
Frequency of snacks consumption	Twice and less in a week	48	98	34	68	37	74	13.256	<0.001**
	More than twice a week	2	4	16	32	13	26		
Frequency of beverage consumption	Thrice or less/week	49	98	44	88	40	80	8.094	0.017*
	More than thrice a week	1	2	6	12	10	20		

**Table 3:** Distribution of caries risk (categorised according to Decayed Missing Filled Teeth scores) of different taster groups.

Caries risk group	Taste groups			Total
	Supertasters	Medium tasters	Non-tasters	
Median DMFT scores	0	2	4	
Low risk (n) DMFT=0	32(61.5%)	10(19.2%)	10(19.2%)	52(34.7%)
Medium risk(n) DMFT=1-3	6(16.7%)	19(52.8%)	11(30.6%)	36(24.0%)
High risk(n) DMFT> 3	12(19.4%)	21(33.9%)	29(46.8%)	62(41.3%)
Total	50(33.3%)	50(33.3%)	50(33.3%)	150(100.0%)
Chi square value (degrees of freedom) – 32.782(4), $p < 0.001^{**}$				

**5. Discussion**

Sensitivity to taste is an inherited trait in children which may be associated with a preference for or rejection of some foods by children. PROP (6-propylthiouracil) paper is a useful tool in determining genetic sensitivity to bitter and sweet tastes. A supertaster child has low taste threshold and is able to perceive stronger bitter and sweet tastes, compared to children who are medium tasters and non-tasters [12]. Children with higher taste threshold to either sweet or bitter taste had higher caries levels [13]. Anatomically, supertasters also have a higher density of taste receptors on the anterior portion of the tongue than non-tasters [5]. Common polymorphisms in genes involved in taste perception accounts for some of the inter-individual differences in food preferences and dietary habits within and between populations. This variability affects food choices and dietary habits, which influences nutritional and health status and the risk of chronic diseases like dental caries [12]. In this context, a cross-sectional survey was conducted to assess the dental caries experience among different taster groups. Students aged 15 years were included in the study as 15 years is WHO index age group [14]. At this age, the permanent teeth are exposed to the oral environment for 3 – 9 years. Hence, the assessment of caries experience in permanent dentition can be conveniently carried out in these age group children. Decayed, Missing and Filled Teeth Index (DMFT) given by Henry T. Klein, Carrole E. Palmer and Knutson J.W was used in the present study to record caries experience. This is the standard index used to assess the dental caries experience in epidemiological studies as recommended by World Health Organization [14]. It becomes easier to compare our results with other studies which have used DMFT Index. The median DMFT scores of supertasters were less compared to median DMFT scores of medium tasters and non-tasters in the present study which was statistically significant ( $p < 0.001$ ). Similar results were observed in other studies [5, 15] where the authors have used DMFT to assess the caries experience of the children. However study by Claire A. Edgemon showed contrasting results [16]. A study by Keskitalo K *et al.* showed that intensity rating of PROP yielded the highest heritability estimates of the taste perceptions of an individual [17]. Hence PROP test was chosen to assess the taste thresholds of the subjects.

Similar studies done using PROP test have shown that nontasters as categorised by PROP test had higher caries experience as compared to medium tasters and non-tasters [5, 22, 24, 25]. A study by Claire A. Edgemon suggests that a subjective measure of taste perception such as PROP may not adequately distinguish people into different groups based on taste sensitivity [16]. There was a significant association between frequency of sweet consumption and taste perception. Supertasters and medium tasters consumed sweets at lesser frequency as compared to non-tasters who were frequent consumers. The results of the present study are in line with the study done by Rupesh *et al.* [5] wherein they found majority of the non-tasters were sweet likers as compared to medium tasters and supertaster. Statistically significant association was found between snacking habit and soft drink consumption with taste perception. Majority of the subjects in the supertaster group consumed less snacks and soft drinks as compared to medium tasters and non-tasters. This could be attributed to the anatomy of the tongue. The development of video-microscopy revealed an association between PROP tasting and tongue anatomy. Supertasters tend to have most fungiform papillae and taste buds [5]. It implicitly means that the satiety centre of the supertasters are satisfied sooner and hence consume less sweets, have less snacks and consume fewer soft drinks compared to medium tasters and non-tasters. When controlled for other factors like gender, socio-economic status, snacking habits, soft drink consumption, Streptococcus Mutans count under regression analysis there was a significant association between frequency of snacking and taste perception. Oral hygiene index simplified given by John C. Green and Jack R. Vermillion, 1964 was used to record oral hygiene status of the subject, which was classified into good, fair and poor. There was statistically significant association between Oral Hygiene Index Simplified score and taste perception. The mean and median Oral Hygiene Index Simplified score of the subjects in Non-taster group was higher when compared to the medium tasters and super-tasters. Similar finding was found in a study by Rupesh *et al.* [5]. Perhaps, frequent consumption of sweets, snacks and soft drinks by non-tasters might lead to poor maintenance of oral hygiene. There was a significant association between caries experience of an individual (as

assessed by Decayed Missing Filled Teeth Index) and taste perception. Caries experience was high among non-tasters compared to supertasters and medium tasters. This is in agreement with previous studies [3, 5, 15, 18]. The findings of this study can be attributed to the fact that taste perception plays a key role in determining individual food preferences and dietary habits [12]. Super tasters perceived stronger tastes from sweet food items in comparison to medium tasters and non-tasters. A study by Sen S *et al.* [13] showed that people with high taste threshold to sweet taste had higher caries levels compared to people with low taste threshold. However, when controlled for other factors like gender, socio-economic status, snacking habits, soft drink consumption under regression analysis there was no significant association between caries experience of an individual (as assessed by Decayed Missing Filled Teeth scores) and taste perception. Under regression analysis, taste perception along with other variables like sex, socio-economic status, liking for sweets, frequency of sweet consumption, frequency of soft beverage consumption and oral hygiene score showed no association with dental caries risk. Frequency of snacking was the only variable significantly associated with caries risk. Study had few limitations, as it was a cross sectional survey design, establishing association was difficult. Further studies with analytical study designs should be carried out to find out the association between taste perception and dental caries risk. study was conducted among students of 15years, further studies are required to assess the predictive capacity of PROP among other age group subjects.

## 6. Conclusion

There was significant difference in the caries experience between 15-year-old school going children with different taste perception. The caries experience among supertasters was lower than medium and non-tasters. Supertasters and medium tasters consumed sweets at lesser frequency, had fewer snacking habits and consumed fewer soft drinks as compared to non-tasters. Majority of super tasters had good oral hygiene compared to medium and non-tasters.

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