

Genetic sensitivity to bitter taste of 6-n Propylthiouracil: A useful diagnostic aid to detect early childhood caries in pre-school children

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PURPOSE: Genetic factor to bitter taste perception appears to be largely mediated by the TAS2R38 gene. The insensitivity to bitter compounds like 6-n-propylthiouracil (PROP) is mediated by this gene. PROP, a pharmacological drug used in treatment of Graves' disease, proved to be useful tool in determining the genetic sensitivity levels to bitter and sweet taste. The purpose of this study is to show much simpler PROP sensitivity technique for the clinical examiner and its application as a diagnostic aid in Early Childhood Caries (ECC) detection among preschool children.

MATERIALS AND METHODS: A total of 119 children belonging to the age group of 36 to 71 months of both sexes, were recruited from A. J. Institute of Dental Sciences, Mangalore (Karnataka). PROP sensitivity test was carried out to determine the inherent genetic ability to taste a bitter or sweet substance. This study used simpler scaling method to find out genetic sensitivity to bitter taste; one who tasted bitter as taster and one who was not able to differentiate/tasted like paper as non-taster. A questionnaire was provided to evaluate their dietary habits and caries experience was recorded. Collected data were tabulated and subjected to statistical analysis.

RESULTS: In the total of 119 children the mean dmfs was definitely higher in non-taster children compared to tasters. The tasters had a mean dmfs value of 9.5120 (S.D. 7.0543) and non-tasters had a value of 7.7250 (S.D. 8.33147), which was statistically significant. The results suggested that there was increase in caries experience among the group of non-tasters as compared to tasters. Tasters tended to be sweet dislikers and non-tasters tended to be sweet likers.

On the whole, tasters had a bad dentition as compared to non tasters.

CONCLUSION: The PROP sensitivity test (filter paper test) proved to be a useful diagnostic tool in determining the genetic sensitivity levels of bitter taste. The knowledge of a child's taste perception can help us in identifying the children who are at higher risk for ECC.

Key words: Early childhood caries, taste perception, 6-n-propylthiouracil

Introduction

Oral health is an integral component of preschool health and well-being. Unfortunately, many children are afflicted with dental caries at an early age, even those as young as 12 months of age. The presence of one or more decayed (non cavitated or cavitated), missing (due to caries), or filled tooth surface in any primary tooth in a child 71 months of age or younger is termed as early childhood caries (ECC).^[1] It is a chronic, transmissible, and infectious disease with a complex and multi-factorial etiology and is strongly influenced by excessive bottle feeding with sugar contained liquids; breast feeding on demand, nursing beyond recommended age for weaning, increase in intake of sugar-rich foods and unbalanced diet.^[2] Other factors associated with ECC include: genetic predisposition, parental education, nutritional, environmental, socioeconomic, and parental style factors.^[1] Those affected often suffer from a reduced oral health-related quality of life when compared with their caries-free peers.

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The carious process is strongly associated with dietary practices.^[3] It has been hypothesized that food preferences of children are learned.^[4] However, the desire to select one food over another is more closely linked to taste and other sensory properties of foods. For many children taste is driving force behind food consumption.^[5] A significant proportion of children's daily energy comes from highly palatable foods such as sweet-fat snacks (cookies, doughnuts, quick breads, etc.), soft drinks, and discretionary fats. Intake of less palatable choices such as fruits, vegetables, and whole grains are now lower than recommended.^[6]

Studies have showed high sugar intake reflects a preference for sweet substance among a majority of children.^[7] However, physiological mechanism that affect a child's craving for sweet substance have not been well documented.^[8] The rapid secular rise of ECC supports significant sweet intake in promoting caries risk, genes presumably interact along with sweet intake conferring difference of caries risk in individuals. One such genetic factor is bitter taste perception, which appears to be large part mediated by the TAS2R38 gene. The insensitivity to bitter compounds like 6-n-propylthiouracil (PROP) is mediated by this gene.^[9] PROP, a pharmacological drug used in treatment of Graves' disease, proved to be useful tool in determining the genetic sensitivity levels to bitter and sweet taste. Inherited behavior and taste thresholds may play an important role in the frequency of carbohydrate intake. Genetic sensitivity to taste may be associated with the preference for or rejection of some foods by children.^[10] A child's preferences for sugar may lead to increase in dental caries and a compromised state of health.^[2,11-13]

Although previous studies have screened for caries and PROP status using threshold procedures in school going children and adults,^[14] these methods require tasting up to 14 solutions and were deemed inappropriate for very young children. The purpose of this study is to show much simpler PROP sensitivity technique for the clinical examiner and its application as a diagnostic aid in ECC detection among preschool children.

Materials and Methods

Source of data

A total number of 119 children belonging to the age

group of 36 to 71 months of both sexes, who reported to the Department of Pedodontics and Preventive Dentistry, A.J. Institute of Dental Sciences, Kuntikana, Mangalore, were the part of this study.

Exclusion criteria

- Children whose parents do not give their consent for the examination.
- Children under any medication and antibiotics three months before the study.
- Children who did not falling under American Society of Anesthesiologists (ASA) physical status of class I.

Methodology

Preparation of the PROP strips

The pure sample of PROP was obtained from the pharmaceuticals and the PROP strips were prepared in the department of pharmaceutics, N.G.S.M Institute of Pharmaceutical Sciences, Mangalore. Whatman filter paper was cut into 2 × 2 cm size and sterilized in an autoclave at 121°C for 15 minutes. The sterilized strips was weighed and stored in the desiccator till they were used for further preparation. 6-n-propylthiouracil (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 weight of the strips after the drying was determined and recorded. The difference between the initial weight of the filter paper and the weight after the impregnation of the drug gives the actual amount of drug impregnated on each strips. An average amount of the drug impregnated on each strip was approximately 1.6 mg.

PROP sensitivity test

A total of 119 children were classified as taster and non-taster by performing PROP sensitivity test. PROP sensitivity test was carried out by placing a filter paper containing approximately 1.6 mg of 6-n-propylthiouracil on the dorsal surface of the subject's tongue for 30 seconds; to determine the inherent genetic ability to taste a bitter or sweet substances. After tasting the paper they

were asked, “Do you taste anything?” If their response was no, they were asked whether it tasted like paper. If they responded that it had no taste and tasted like paper, they were classified as non-tasters. If they responded that it tasted yucky or bad they were classified as tasters. If they responded that they did not know what it tasted like or provided an ambiguous response, they were re-tested at a later time.^[15] Facial expressions were observed during the tasting to support the verbal response and to identify any ambiguous or conflicting responses.^[14,16,17]

Caries experience

The caries experience (dmfs index) was recorded using visible light, mouth mirror, and Community periodontal index (CPI) probe. All teeth were examined for coronal surface caries and restorations. The number of decayed, missing, and filled surfaces (dmfs) in the coronal portion of each tooth was determined.^[18,19]

The results were subjected to statistical analysis using prevalence test, Mann Whitney-U Test and Kruskal value test. Analysis was done using SPSS software version 11.

Results

In the total of 119 children the mean dmfs was definitely higher in non-taster children compared to tasters. The tasters had a mean dmfs value of 9.5120 (S.D 7.0543) and non-tasters had a value of 7.7250 (S.D 8.33147), which was statistically significant. [Table 1, Figure 1]

Discussion

ECC is the most common chronic disease in childhood, resulting in a severe problem for worldwide public health. It is a virulent form of dental caries that can destroy the primary dentition of toddlers and preschool children. Hence, the present study was conducted to show genetic sensitivity to bitter taste of 6-n propylthiouracil could be

used as a diagnostic tool for ECC in pre-school children.

Of the 119 preschool children, of low socioeconomic status, screened at A.J Institute of Dental Sciences, Mangalore; 33.13% were found to be tasters and 63.86% were non-tasters. The children who were in taster and non-taster category could be identified easily as they would either find the taste of PROP extremely bitter or absolute tasteless, respectively. We note, however, that thresholds are a more definitive method for separating tasters from non-tasters.^[20] Thresholds were not used in this study as we are aware that children at this young age could not complete the task because they are at stage of developing psyche and they do not have the cognitive abilities to give accurate results. Studies using thresholds in children have reported the percentage of non-tasters as varying from approximately 18-35%.^[14,21,22] While the percentage of non-tasters identified in the present study was within the range, which is slightly less sensitive than thresholds.

There are several techniques of using 6-n-propylthiouracil either by one solution tests, three solution tests, and fourteen solution tests or by using PROP strip/disk method. Although previous studies were conducted using PROP paper strip method in young children, their results were found to be inappropriate. One solution test was used in these instances. This was because they used Labeled Magnitude Scale (LMS) for evaluating the samples. The LMS is a quasilogarithmic scale with label descriptors that is equivalent to magnitude estimation. LMS is useful for quantifying

Table 1: Mean dmfs among various groups of tasters

	N	Mean	S.D	Minimum	Maximum
Taster	43	9.5120	7.0543	2.00	42.00
Non Taster	76	7.7250	8.33147	1.00	35.00

Z = 2.195, P = 0.046 sig

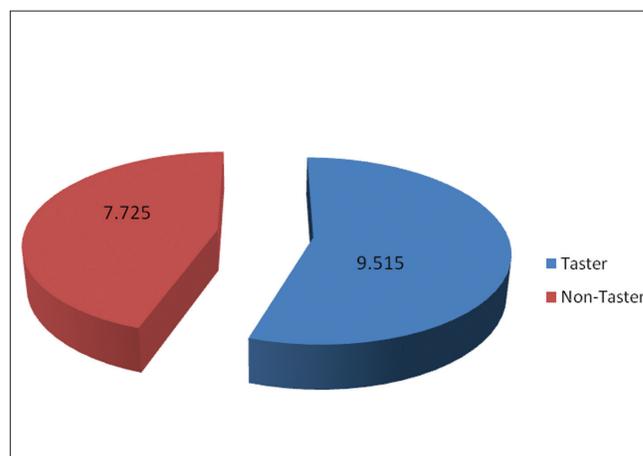


Figure 1: Pie diagram showing the mean dmfs among the taster group

various types of oral sensations, particularly those that are strong or lingering such as bitterness or irritation. However, in this study we used a much simpler scaling; one who tasted bitter as taster and one who was not able to differentiate/tasted like paper as non-taster. We found children at this young age are in a state of developing psyche and undergo behavioral changes. Hence, use of LMS scales in children below 71 months of age would not produce appropriate results.

Moreover, we modeled our methods after those of others in using facial expression to inform classification of children as PROP tasters. Mennella *et al.* has found that at least in older children (aged 5-10 years), reliance on facial expression to classify taster status is questionable.^[23] Our experience in conducting this protocol suggested that facial expression in these young children was a valid indicator of tasting bitter, but this question requires further investigation.

Overall caries experience (dmfs) was found to be significantly higher in non-tasters than in tasters ($Z = 2.195$, $P = 0.046$ sig). Majority of the non-tasters were sweet likers and preferred strong tasting food products, while majority of the tasters were sweet dislikers and preferred weak tastes. There was a significant increase in the overall caries experience in the non taster population, as the genetic ability to detect PROP taste decreased. Thus the data recorded in the study reveals that PROP non-tasters tended to be 'sweet-liker' with increased caries risk and PROP tasters tended to be 'sweet-dislikers' with decreased caries risk.

Tasters or sweet dislikers might avoid sweet food because their oral sensations are too intense and thus less pleasant to accept the intensely bitter, strong sweet substances thus making tasters less prone to decay. This could be also due to the number of distribution of fungiform papillae on the tongue, which are present in high numbers in anterior third, on the sides and tip of the tongue. The number of fungiform papillae is related to genetic variation in the ability to taste. Tasters have a higher growth of fungiform papillae as compared to non-tasters.^[24]

The ability to taste 6-n-propylthiouracil (PROP) is an inherited trait. Food preferences can be better characterized when assessed in conjunction with personal characteristics such as cultural and familial

experiences, personality factors and attitude about nutrition and health.^[25] Thus, the non-taster children may have a higher concentration and higher frequency of sugar intake compared to children who are tasters, and are therefore more susceptible to dental caries and overweight.

A strong positive correlation was established in the present study between genetic sensitivity levels of a preschooler with ECC experience. The study demonstrates use PROP strip technique in preschool going children, which could be much convenient method to determine caries risk for a clinical examiner to perform chair side. Nonetheless, the children's young age may have increased the chance that misclassification occurred on basis of behavior measures of PROP taster status, and further studies may benefit from this simple identification of PROP taster. Furthermore, understanding factors underlying the preference for and selection of foods may have important implication for improving dietary composition and reducing childhood caries risk. It is of paramount importance that the caregiver/parent be aware of the potential ramifications of each etiological factor and correct it at the earliest. Proper anticipatory guidance, periodic dental checkups, and adequate preventive and corrective treatment for the diseased can avoid the severity of ECC in children.

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