

# Association of Mothers' Genetic Taste Perception to Eating Habits and Its Influence on Early Childhood Caries in Preschool Children: An Analytical Study

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## ABSTRACT

**Aims:** To examine (1) the association of mothers' 6-n-propylthiouracil (PROP) sensitivity with snacking habits and caries experience of both the mother and their 2–5-year-old preschool children and (2) the association of feeding habits with caries prevalence in 2–5-year-old children.

**Materials and methods:** In this analytical cross-sectional study, 2–5-year-old preschool children were clinically examined by a single calibrated examiner and divided into two groups of 80 children with early childhood caries (ECC) and 80 without. Mothers of the children were clinically examined and a second blinded investigator determined their genetic taste type using PROP. Data regarding feeding practices of the child and snacking habits of the mother and child were obtained using questionnaires. The data obtained were statistically analyzed.

**Results:** Cariogenic snack consumption was more among nontaster mothers and their children ( $p$  value  $< 0.001$ ). More number of children of the nontaster mothers in the ECC group were bottle-fed with sweetened beverages ( $n = 24$ ) and received sweet snacks as rewards ( $n = 32$ ). Caries prevalence of 73%, 20%, and 7% was seen in children of nontaster, medium taster, and supertaster mothers, respectively ( $p$  value  $< 0.05$ ). Significant association was found between mother's caries activity, past bottle-feeding, receiving sweet snacks as reward and their child's caries experience.

**Conclusion:** Mothers' PROP sensitivity was significantly associated with snacking habits and caries experience of their children. Mothers' PROP type could be an important factor that may determine and explain the dental caries experience in their 2–5-year-old preschool children.

**Clinical significance:** Early identification of nontaster mothers may prove beneficial in guiding them and consecutively their children toward healthy dietary habits, leading to lesser incidence of caries and their better overall wellbeing.

**Keywords:** Caries experience, Early childhood caries, Genetic taste perception, Preschool children, Snacking habits.

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## INTRODUCTION

Early childhood caries (ECC) continues to be a widespread public health problem, especially, in a developing country such as India where every one out of two children is affected by dental caries.<sup>1</sup> The reportedly high prevalence of ECC in India<sup>2</sup> is alarming not only because of its nutritional, physical, and psychological implications on the children but also due to the burden it places on their families and communities.<sup>3</sup>

Over the years, several ECC risk factors have been evaluated and diet, in particular, sugar has been well established as a major risk factor.<sup>4</sup> Studies have revealed that higher and more frequent sugar intake increases the risk of caries formation in children,<sup>5,6</sup> which leads us to speculate that frequent sugar intake may reflect a preference for sweet tasting foods. Food preferences in children are shaped by a complex interplay of innate, learned, and environmental factors.<sup>7</sup> Innate mechanisms could be related to a genetic sensitivity to taste, as evidenced from the widely studied ability to taste compounds that contain an N-C=S group (thiocyanate moiety), such as phenylthiocarbamide (PTC) and 6-n-propylthiouracil (PROP). While some individuals taste these chemicals as intensely bitter (supertasters), others either cannot taste them or require high concentrations to recognize its presence (nontasters and medium tasters).<sup>8</sup> This genetic sensitivity to taste has been further associated with a like/dislike of bitter and sweet tastes. Supertasters are able to

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perceive taste in a lower concentration of bitter or sweet substance than nontasters. Nontasters are therefore more likely to consume higher concentration and frequencies of sugar intake compared to medium or supertasters.<sup>9</sup>

Research has shown that food habits and preferences in young children are more likely to be influenced by their parents, not only through the foods they make accessible to children, but also via their own eating styles, behavior at mealtimes, and child feeding practices.<sup>7,10-13</sup> In this regard, mothers are of particular interest, as they have a highly significant role in nurturing. As mothers have

been shown to rarely serve food items that they themselves dislike, they may inadvertently limit the foods that are offered to their children.<sup>14</sup> Hence, regular exposure to sugar-containing foods and drinks made accessible by mothers from an early age, may be a determining factor in their child's preference for sweet foods and pattern of sugar consumption.<sup>15</sup> This may in turn affect the caries prevalence in their children. In this regard, not many studies have been done associating mothers' genetic taste sensitivity to PROP and dental caries prevalence of their preschool aged children (2–5 years).

Therefore, the present study aimed to examine (1) the association of mothers' PROP sensitivity with snacking habits and caries experience of both the mothers and their 2–5-year-old preschool children and (2) the association of feeding habits with the caries prevalence in 2–5-year-old children.

## MATERIALS AND METHODS

This analytical cross-sectional study was conducted in healthy children with and without ECC aged between 2 and 5 years, attending local preschools in Bengaluru, and their mothers. The study proposal was reviewed and approved by the Institutional Ethical Committee. This study has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki). The size of the sample was derived using G\*Power 3.0.10 software with an effect size of 0.35, power (1-β) of the study set at 0.81, and a total sample size of 160 (80 in each group) was determined. Informed consent was obtained from the mothers of the participating children prior to the study.

2–5-year-old preschool children were screened, by a single examiner, for the presence of ECC and 80 children with ECC and 80 children without ECC were chosen for the study based on the selection criteria. Children and mothers with underlying systemic disorders and mothers having any medical history which alters taste sensation or known allergy/history of adverse reactions to 6-n-propylthiouracil, and by extension their children, were excluded from the study. The selected children and their mothers were clinically examined according to WHO criteria for oral health assessment (2013) with mouth mirror and probe and the decayed, missing, and filled surface values were recorded.

Information regarding feeding practices of the child (e.g., bottle-feeding and its contents, sweet snacks as reward) and snacking habits of the mother and child were recorded using two questionnaires. The types of snacks consumed were grouped into cariogenic snacks (chocolates, sweets, cakes, starchy refined carbohydrates such as chips, bread, pasta, crackers, biscuits, and sugary cereals) and non-cariogenic snacks (fruits, vegetables, cheese, milk, food items made of whole grains, and nonsugary cereals).

A second investigator blinded to the clinical status of the participants conducted the PROP taste test on the mothers. A 2 x 2 cm strip of Whatman grade-1 filter paper impregnated with approximately 1.6 mg of propylthiouracil was prepared<sup>16</sup> and used

for the same. The mothers were instructed to place the whole piece of filter paper on the dorsal surface of the tongue and thoroughly wet it with saliva for 30 seconds. After removing the filter paper, the mothers were asked to quantify the intensity of the bitter taste using the Green's Labeled Magnitude Scale and were classified into groups of supertasters (> 60), medium tasters (12–60), and nontasters (< 12).<sup>17,18</sup>

Mothers and children received education regarding diet and its relationship to dental caries and healthy eating habits. They were then guided on the oral hygiene practices to be followed.

The PROP status of the mothers of both the groups was evaluated for association with their own snacking habits and decayed, missing and filled surface scores, as well as those of their children. The data regarding feeding practices and dmfs of the children were evaluated for associations.

All the data collected were analyzed by the Statistical Package for the Social Sciences software, SPSS version 18.5 (SPSS Inc.; Chicago, IL, USA). Proportions were compared using Chi-square test of significance. The student "t" test was used to determine whether there was a statistical difference between the groups in the parameters measured. One-way analysis of variance (ANOVA) was used to determine the difference in dental caries experiences of the children and mothers decayed, missing and filled tooth surfaces (DMFS) based on the mothers' PROP type. A *p* value <0.05 was considered as statistically significant.

## RESULTS

The ECC group comprised of 29 males and 51 females, whereas the non-ECC group had 40 males and 40 females. Mothers of the children ranged in age from 22 to 44 years. Among 160 mothers tested for PROP sensitivity, 44 were supertasters, 59 were medium tasters, and 57 were nontasters. A significant number of mothers of the children in the ECC group were nontasters, whereas, a majority of mothers of children in the non-ECC group were supertasters (*p* value <0.001) (Table 1).

84.2% of nontaster mothers (*n* = 48), 54.2% of medium taster (*n* = 32), and 31.8% of supertaster mothers (*n* = 14) consumed cariogenic snacks (*p* value <0.001), while 91.2% (*n* = 52), 55.9% (*n* = 33), and 34.1% (*n* = 15) children of nontaster mothers, medium taster mothers, and supertaster mothers, respectively, consumed cariogenic snacks (*p* value <0.001).

Figures 1 and 2 show the distribution of children and mothers of the children in the ECC and non-ECC groups according to the type of snacks consumed. 72 children in the ECC group were found to consume cariogenic snacks in comparison to 28 children in the non-ECC group. A statistically significant association was seen here with *p* value <0.001. More number of children of nontaster mothers in the ECC group were bottle-fed with sweetened beverages (*n* = 24) (*p* value = 0.710) and received sweet snacks as rewards (*n* = 32) (*p* value = 0.893) compared to children of medium taster and supertaster mothers (Fig. 3).

**Table 1:** Distribution of children in the early childhood caries (ECC) and non-ECC groups based on the PROP sensitivity of the mothers

Group	Nontaster	Medium taster	Supertaster	χ <sup>2</sup>	<i>p</i> value
ECC	49	25	6	54.137	< 0.001*
Non-ECC	8	34	38		
Total	57	59	44		

\* Significant (*p* <0.05), Chi-square test



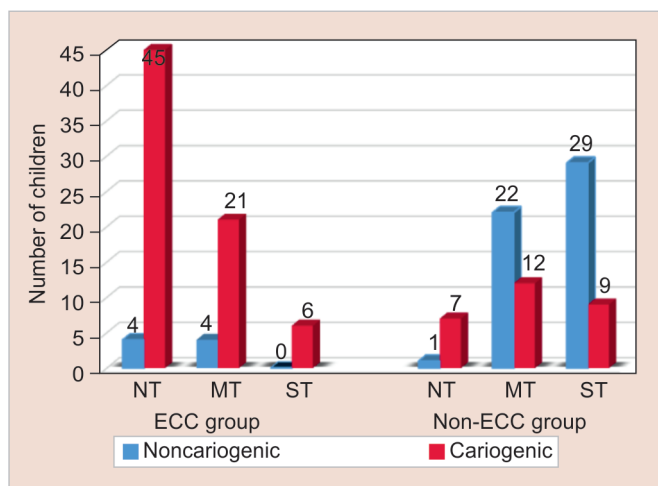


Fig. 1: Distribution of children in early childhood caries (ECC) and non-ECC groups according to the type of snacks consumed and PROP sensitivity of their mothers

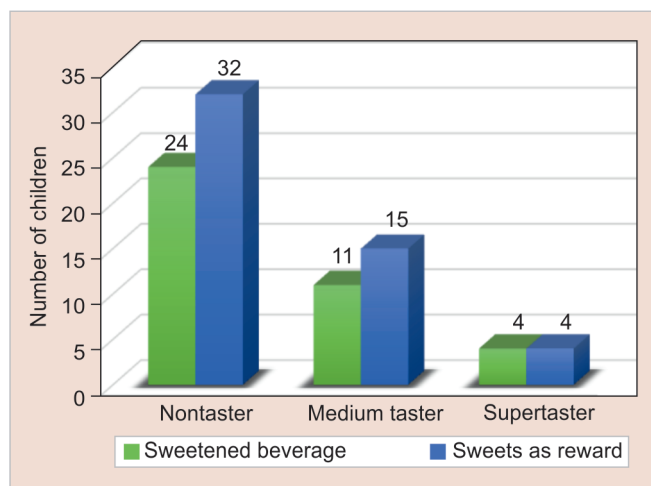


Fig. 3: Distribution of children of nontaster, medium taster, and supertaster mothers in the early childhood caries (ECC) group according to bottle-feeding with sweetened beverages and receiving sweet snacks as reward

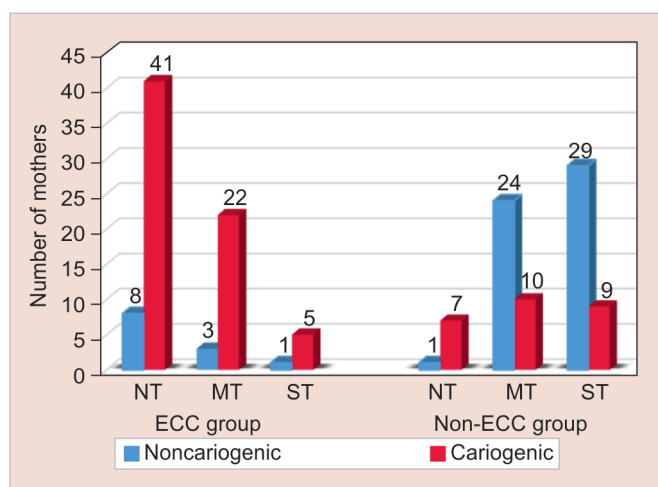


Fig. 2: Distribution of mothers of children in early childhood caries (ECC) and non-ECC groups according to their PROP sensitivity and type of snacks consumed

The association between mean DMFS of the nontaster, medium taster, and supertaster mothers and the mean dmfs of their children can be seen in Table 2. The prevalence of dental caries was highest among children of nontaster mothers (61%) (Fig. 4). The association was statistically significant ( $p$  value = 0.002).

Children who had been bottle-fed had significantly higher mean dmfs scores ( $9.95 \pm 6.4$ ) compared to those who were not ( $7.17 \pm 4.2$ ) ( $p$  value = 0.037). Higher mean dmfs scores of  $9.33 \pm 5.5$  were seen in children who received sweet snacks as reward ( $n = 51$ ) in comparison to children who were not receiving any sweet snacks as reward ( $6.4 \pm 4.0$ ) ( $n = 29$ ). The result was statistically significant with  $p$  value = 0.025. Although higher mean dmfs scores ( $9.62 \pm 6.4$ ) were present in children whose mothers reported adding sugar to the contents of the bottle, the result was not statistically significant ( $p$  value = 0.231).

## DISCUSSION

The accidental discovery of taste sensitivity to PTC by Arthur L Fox in 1931 paved the way for extensive research into the field of genetic

taste sensitivity, which led to the implication of the *TAS2R38* gene in the genetic inheritance of taste.<sup>19</sup> The drug PROP, used in this study, belongs to a class of compounds called “thioureas”.<sup>20</sup> PROP tasters have been found to perceive greater bitterness from caffeine, saccharin, KCl, sodium benzoate, potassium benzoate and ethyl alcohol, greater sweetness from sugars, and greater oral burn from capsaicin.<sup>21</sup> This could be attributed to the findings by Reedy et al.<sup>22</sup> and Bartoshuk et al.<sup>21</sup> that supertasters tended to have a higher density of taste receptors on the anterior tongue (fungiform papillae and taste buds) than the nontasters and medium tasters. Several studies have related children’s PROP taste sensitivity to bitter and sweet food preference,<sup>9,21,23</sup> obesity,<sup>18</sup> and dental caries;<sup>516</sup> yet, research relating mothers’ genetic taste sensitivity to PROP and ECC in their children is limited.

Despite the changing family dynamics, mothers still remain the primary caregivers in majority of Indian households. Mother, being likened to the “gatekeeper” by Koivisto and Sjöden,<sup>11</sup> has a key role in the establishment of food choices and eating behaviors of her children and as such, it is possible that her taste preference may influence what the child is fed and, therefore, may influence the dental caries risk of her children. This could be related to in the present study where 58.8% of the mothers reported frequent daily consumption of cariogenic snacks, the majority being nontasters and 62.5% of the children were reported to do the same, with the majority being children of PROP nontaster mothers. Though bottle-feeding with sweetened beverages and receiving sweet snacks as a reward were seen more among children of nontaster mothers, the results were not statistically significant. In this study, the dental caries experience was found to be higher for PROP nontaster mothers and the children of PROP nontaster mothers than the medium and supertaster mothers and their children. This is similar to the result obtained by Alanzi et al.<sup>24</sup> and indicates a strong association between mothers’ genetic taste sensitivity to PROP and ECC in their children.

In the present study, mothers who had dental caries had children with higher dental caries experience than children of mothers who reported no dental caries. This is in agreement with previous studies done by Matilla et al.,<sup>25</sup> Ersin et al.,<sup>26</sup> Weintraub et al.,<sup>27</sup> Bhat et al.<sup>28</sup> and indicates that mothers’ dental caries status is

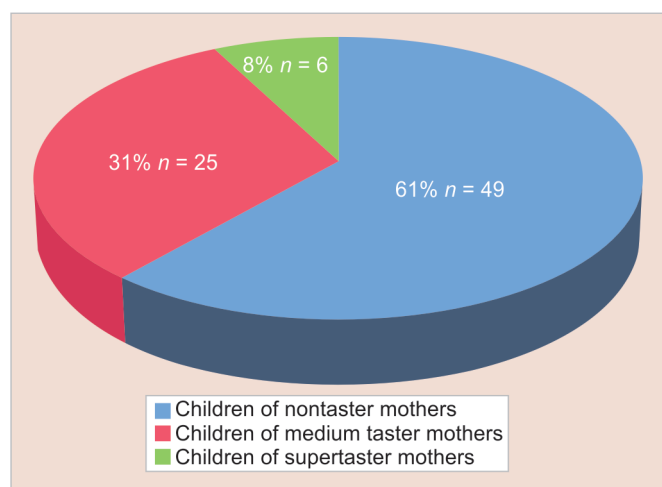
**Table 2:** Comparison between mean DMFS of supertaster, medium taster, and nontaster mothers and the mean dmfs of their children

	Nontaster n = 49	Medium taster n = 25	Supertaster n = 6	"F" value	p value
DMFS of the mother					
Mean	10.88	5.16	6.17	10.876	<0.001*
SD	5.99	3.36	3.76		
dmfs of the child					
Mean	8.56	2.39	0.80	6.565	<0.001*
SD	6.31	3.92	2.31		

SD: standard deviation, one-way ANOVA

\*Significant ( $p < 0.05$ )

(DMFS, dmfs - Decayed Missing and Filled tooth surfaces: decayed, missing, filled surfaces)



**Fig. 4:** Prevalence of dental caries among children of nontaster, medium taster, and supertaster mothers

a good risk indicator for their children. A significant association was seen between bottle-feeding, receiving sweet snacks as reward, and higher dmfs scores in children. These are similar to the findings of Jose and King,<sup>29</sup> Gaidhane et al.,<sup>30</sup> and Koya et al.<sup>31</sup>

Barjatya et al.<sup>32</sup> reported that bottle-feeding irrespective of its duration and whether it is given in the day or night had a higher risk of having ECC and, hence, further reinforce these as well proven risk factors for ECC. Our study did not find any significant relation between adding sugar to contents of the bottle and dmfs scores. Similar results were reported by Ozer et al.,<sup>33</sup> while Shrutha et al.<sup>34</sup> have reported a high prevalence of dental caries among 3–5-year-old children fed with additional sugar in milk.

This study, therefore, emphasizes the significant role of mothers' genetic taste perception and food choices in the food habits of 2–5-year-old children. Dietary habits acquired in childhood persist through to adulthood<sup>7</sup> and as such, early identification of nontaster mothers may prove beneficial in guiding them toward healthy dietary habits, whereupon, the same may be inculcated in their children thereby leading to lesser incidence of caries and a better overall wellbeing. We may go so far as to suggest that PROP screening of the mother may be included as a part of anticipatory guidance such that prevention can start early.

## CONCLUSION

A significant majority of PROP nontaster mothers did indeed show a preference for cariogenic snacks, which was reflected in the snacking habits of their children. Furthermore, PROP nontaster mothers

and their children showed higher dental caries experience than medium-/supertaster mothers and their children. Hence, mothers' PROP type could be an important factor that may determine and explain the dental caries experience in their 2–5-year-old preschool children. Factors such as past bottle-feeding, receiving sweet snacks as reward, and mothers' caries activity were positively associated with caries experience of the children.

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