Original Article

Correlation of Mother and Child's Taste Perception and their Caries Experience

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Abstract

Aim and Background: Nowadays, clinical assessment of caries susceptibility is evaluated by the individuals taste perception. As food habits of the child are mostly influenced by the parents (mothers), it would be beneficial to assess the relation between mother and child's taste status and their caries experience to predict the caries susceptibility of the child. **Methodology:** A convenience sample of 310 mother–child dyads of both the sexes were selected. After obtaining the data on the taste preferences, dietary habits, and oral hygiene practices, caries experience of both the mother and child were recorded using the DMFT and defs indices, followed by the taste assessment using 6-n propylthiouracil (PROP) tester strips. **Results:** Irrespective of the taste status, the majority of the mother and child dyads showed preference to sweet foods. A statistically significant relationship between taste status and caries experience was noticed among mothers and children individually. However, there was no significant association between mother and child taste status. Whereas, a weak-positive correlation is observed between the mother and child's caries experience. The children of supertaster mothers have relatively less caries experience compared to children of moderate and nontaster mothers, which was not statistically significant. **Conclusion:** Mother's taste perception or caries experience may not always be a risk predictor for their child's caries experience, but the PROP tester strips were very effective in predicting the caries risk of an individual.

Keywords: *6-n propylthiouracil tester strips, 6-n propylthiouracil, caries experience, taste sensitivity, taste status, taste threshold*

Introduction

Oral health is an important aspect of general health and well-being of any individual. Inspite of increasing dental awareness, the high prevalence of dental caries among children still poses a significant health problem. For children, taste is the main driving force behind food consumption. A significant proportion of children's daily energy comes from highly palatable foods, soft drinks, and discretionary fats. Whereas intake of foods such as fruits, vegetables, and whole grains are much lower than recommended, thereby clearly reflecting a child's preference to cariogenic diet.[1]

Till date, attempts such as evaluating the *Streptococcus mutans* and lactobacilli counts, socioeconomic factors, past caries experience, frequency, and amount of sugar intake have been carried out to identify children with high caries risk. However, it is difficult to identify "at-risk" population with currently available caries screening methods.[2] The role of taste status as a powerful predictor of food selection, which might lead to dental caries, has not been given its due consideration. The knowledge of an individual's taste threshold facilitates the identification of children who are at risk of developing dental caries. Hence, recent concepts such as genetic taste sensitivity and taste thresholds have been evolved to assess the caries risk at an early stage.[3]

Inherited behavior and taste threshold play an important role in the frequency of carbohydrate intake. Genetic sensitivity to taste may be associated with the preference or rejection of some foods by children. In 1991, a genetic variation in the ability to taste the bitterness of the chemical 6-n-propylthiouracil (PROP) was found to be associated with variation in food preferences in children. In clinical practice, the bitter taste of PROP was found to be a consistent factor for assessing genetic taste sensitivity levels, which is influenced by TAS2R38 gene.[4]

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Parents modeling of food consumption can have a powerful effect on their child's consumption.[5] Johannsen *et al*.[6] confirmed the influence of parents eating behavior of their children. In addition, using sugary snacks as reward have shown to increase the child's preference for that food. It is possible that a mother's taste preference may influence what the child is fed with, which in turn reflects the dental caries risk of the child.[4] Hence, the present study is aimed at testing the hypothesis that nontasters have a higher caries experience when compared to super and medium tasters and also to assess the correlation between mother's taste perception and the child's caries experience.

Methodology

After obtaining the clearance from the Institutional Ethical Committee, the sample size (294) was determined using the formula $n = (Z\alpha+Z\beta)^2pq/d^2$. In this cross-sectional study, a sample of 400 children of both sexes aged between 6 and 12 years, who were accompanied by their mothers were considered. Children who fall under the American Society of Anesthesiologists Physical Status I, children and/or mothers without any systemic disorders, and stable mental condition were included in the study. Pregnant mothers and lactating mothers, participants who have nasal congestion or olfactory dysfunction, medical/hereditary condition or long-term/current regimen of medication that can affect the salivary flow, and children who are undergoing orthodontic treatment were excluded from the study. The purpose of the study was clearly explained to the child and the parent before seeking their consent. Out of the selected samples, only 310 children/mother pairs agreed to participate voluntarily.

The Whatman filter paper was cut into 2 cm × 2 cm size and sterilized in an autoclave at 121°C for 15 min. The sterilized strips were weighed and stored in the desiccator till further use. The drug PROP (Swapnroop Drugs and Pharmaceuticals, Maharashtra) 10 mg/ml was dissolved in 5 ml of ethyl alcohol. Then, ten paper strips were soaked in the prepared solution for 1 h so that the drug absorbs completely. Further, the strips were allowed to air dry at room temperature, weighed in electronic weighing machine, and the values were recorded. The difference between the pre- and postimmersion values will give the actual amount of drug impregnated in each strip, which is approximately 1.6 mg/strip [Figure 1a].[1]

Meanwhile, the mothers of the selected sample were asked to fill the self-designed questionnaire which constituted general information, their past medical and dental history, dietary preferences, dietary habits, and oral hygiene practices.

The caries experience of both mother and child were recorded following the WHO criteria.[7] Both primary and permanent dentitions were included and the participants with a total decayed-missing-filled teeth (DMFT)/deft score of >5 were considered as a high caries group.

Figure 1: (a) Armamentarium (b) Assessing taste perception

The taste status/threshold was assessed by placing a PROP tester strip on the dorsal surface of the individual's tongue for 30 s; to determine the inherent genetic ability to taste a bitter or sweet substance [Figure 1b]. Based on their ability to rate the intensity of bitter taste on a Labeled Magnitude Scale (LMS) given by Green *et al*.,[8] they were classified into supertasters, medium tasters, and nontasters. Facial expressions were also observed during the tasting to support the verbal response. To eliminate any ambiguous and conflicting responses, two plain filter paper strips were used intermittently, thereby blinding the patient.

The entire clinical procedure of recording caries experience and determining the taste perception was carried out by a single examiner. However, to avoid bias and test the validity of the results, samples were randomly reevaluated by another examiner who were unaware of the prior results. As the interexaminer variability was not statistically significant ($P > 0.05$), the results obtained by principal investigator were considered. The values, thus obtained were tabulated and subjected to statistical analysis using Micosoft Excel and SPSS version 20 software (IBM SPSS Statistics for windows version 20, Armonk NY, USA)

Results

Irrespective of the taste status, both mothers and children showed preference for sweet food. However, no significant correlation was noticed when the association between taste status and food preferences in both mothers and children were compared.

Table 1 demonstrates the relationship between taste status and caries experience among mother and children. Kruskal–Wallis test showed statistically significant difference ($P < 0.0001$) in the mean DMFT scores among the groups in both mothers and children. Supertasters had the least mean DMFT/def score compared to medium tasters and nontasters. Irrespective of the mother's taste status, majority of the children are supertasters. Mantel–Haenszel Chi-square test ($P = 0.2$) failed to

demonstrate the association between mother and child taste status [Table 2].

Graph 1 shows the relationship between the mother and child caries experience. The histograms are a pictorial representation of DMFT and def scores, and the curve is a normal distribution curve. From the Graph 1a and b, it can be inferred that both DMFT scores (mothers' caries experience) and def scores (children's caries experience) are right skewed. Scatter plot [Graph 1c] shows the correlation between mother and child caries experience. This scatter plot shows how much one variable is affected by the other (DMFT and def). The dotted line in the graph is moving upward as the DMFT score increases, which means that there is a positive correlation between DMFT scores and def scores. However, there is a weak-positive correlation with a Pearson correlation coefficient of 0.16 [Table 3].

The correlation between mother's taste status and children's caries experience was illustrated in Table 4. The mean DMFT/def score (caries experience) of supertaster mothers' children is 2.20, whereas for children of moderate taster mothers and nontaster mothers are 2.61 and 2.87, respectively. Analysis shows that although mean def score in children of supertaster mothers is low compared to the children of moderate and nontaster mothers, it did not reach statistical significance level ($P = 0.10$).

Table 1: Correlation between taste status and caries experience of mother and child

	Mean DMFT	SD	Kruskal-Wallis (χ^2)	*P*
Mother taste status				
Nontasters	4.14	3.99	42.8	<0.0001*
Moderate tasters	3.83	2.64		
Supertasters	1.77	2.75		
Child taste status				
Nontasters	4.16	3.88	34.6	<0.0001*
Moderate tasters	3.24	2.89		
Supertasters	1.55	2.17		

*Denotes statistical significance, SD: Standard deviation; DMFT: Decayed-missing-filled teeth

Discussion

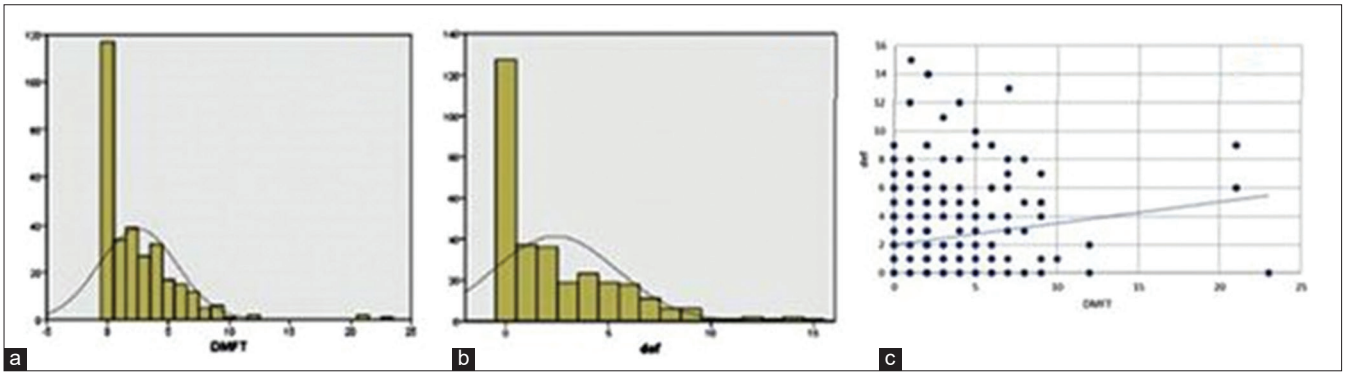
Recent concepts such as genetic taste sensitivity and taste thresholds have been evolved to identify the caries risk at an early stage. It has been extensively documented in the literature that the drug PROP is widely used to test the genetic sensitivity of the individuals in eliciting response to sweet taste on a hedonic scale. Sensitivity of PROP strip is known to be a reliable test in assessing this genetic sensitivity to bitter taste, which is an inherent genetic feature.[9] Genetic sensitivity to bitter taste may be associated with the preference for or rejection of some foods by children.[10]

PROP is a medication used in the treatment of Grave's disease (hyperthyroidism).[11] The therapeutic safety and efficacy of propylthiouracil are well established and are not considered as a human carcinogen or teratogen. Thus, the PROP-impregnated filter paper used for this research contains a very low concentration of 1.6 mg approximately. It is unlikely that casual exposure to PROP in a taste study poses a foreseeable risk to human subjects.[12]

PROP tasters are more sensitive to many oral sensations, including bitter and sweet taste and the sensation of fats.[13] When the connection between PROP taste sensitivity and sweet preference were explored, it was found that PROP tasters were more likely to dislike the taste of sweet solutions, whereas nontasters were almost always those

Table 2: Association between mother and child's taste status

Mother taste status (*n*)	Child taste status			Test statistic	*P*
	Nontaster	Moderate tasters	Supertasters	χ^2 (Mantel-Haenszel)	
Nontasters (63)	19	6	38	1.53	0.2
Moderate tasters (36)	11	4	21		
Supertasters (211)	48	23	140		



Graph 1: (a-c) Correlation between mother and child's caries experience

Table 3: Correlation between mother and child's caries experience

Variable	*n*	Mean	Pearson correlation	*P*
Def	310	2.39	0.16	0.004*
DMFT	310	2.49		

*Denotes statistical significance, DMFT: Decayed-missing-filled teeth

Table 4: Correlation between mother's taste status and children's caries experience

Mother taste status	*n*	Mean (def)	SD	Kruskal-Wallis (χ^2)	*P*
Nontasters	63	2.87	3.24	4.48	0.10
Moderate tasters	36	2.61	2.70		
Supertasters	211	2.20	2.96		

SD: Standard deviation

with a sweet preference. Tasters are more sensitive to sweetness, and they perceive lower concentrations of sugars to be sweeter and they also tend to dislike intensely sweet foods.[3]

A study by Weintraub *et al.*[14] found that maternal-untreated dental caries almost doubled the odds of children's untreated dental caries and significantly increased the child's dental caries severity by approximately three surfaces. These findings indicate that mothers oral health status is a good risk indicator for their children. Studies by Ersin *et al.*,[15] Smith *et al.*,[16] and Manna *et al.*[17] found that the mothers' dental caries status has been related to preschool children's dental caries status. Alanzi *et al.*[4] stated that mothers who are PROP nontasters may consume higher amounts of sugars and have a high frequency of sugar intake compared to supertasters, and also, choose to give more sweets to their children. Thus, a PROP screening of mothers may facilitate the identification of caries risk for their children.

Numerous studies have evaluated the association between taste perception/thresholds and caries experience among children or adults. As most of the studies showed a significant positive correlation, the present study is aimed with a hypothesis that the nontasters are highly susceptible to dental caries when compared to medium- and supertasters and to determine if there is any similar correlation between mother and child's taste status and their caries experience.

In the present study, the taste status of mothers and children were assessed by using the PROP tester strips. Zhao *et al.*[12] stated that use of the paper-disc method is a valid and reliable screening tool for classifying individuals by PROP taster status.

For the participants' convenience, to express the intensity of bitterness of the PROP tester strip, a LMS was used. The LMS is a semantically labeled scale of the sensation intensity that was developed for the study of oral somatosensation and gestation. LMS is a quasi-logarithmic, 100 mm scale, in which labeled descriptors are placed along the length of the scale, with the strongest imaginable on the high end of the scale.[3] LMS provided not only an absolute lower bound at which there is no sensation but also an absolute upper bound labeled "strongly imaginable of any kind." It was believed that preparing the scale in this manner puts different people's responses on the same metric scale creating a "universal ruler."[18]

The LMS which was used in this study measures the intensity of bitter taste of PROP in six verbal labels which were arranged according to the geometric means of their rated magnitudes. The magnitude increases as the intensity increases.[19] Children younger than 6 years of age were not included in our study group due to their inability to understand the LMS Scale. Based on the LMS ratings, participants were classified as: (a) supertasters (>60), (b) medium tasters (>12–<60), and (c) nontasters (<12).[8]

Based on the LMS ratings, out of the 310 mother–child pairs, 211 mothers and 199 children rated the PROP tester strip as intensely bitter and were subsequently categorized as "supertasters." 63 mothers and 78 children who rated the strip as weak or barely bitter in taste were categorized as "nontasters." The remaining 36 mothers and 33 children rated the PROP tester strip as moderately bitter to taste and hence categorized as "medium tasters." Out of the 620 participants (both mother and child), majority of them cumulatively (410) were supertasters, while only 69 were moderate tasters and 141 were bad tasters. These findings were in accordance with the study conducted by Lin[2] where the number of nontasters was found to be significantly lower (11%) than supertasters.

When food preferences are compared with taste status, 63.5% of nontaster mothers were sweet likers and 78.2% of nontaster children preferred sweets, emphasizing that majority of nontasters prefer sweets. However, when the food preference among supertasters was evaluated, only 50% of supertaster mothers and 29% of supertaster children disliked sweet food which is contradicting with this hypothesis. Thus, the inference is that a majority of the participants in the study (53.8% of the mothers and 74.2% of the children) were sweet likers irrespective of their taste status. This can be attributed to the fact that individuals prefer highly palatable foods such as sweet-fat snacks and soft drinks over less palatable choices such as fruits, vegetables, and whole grains.[13] Drewnowski *et al.*[20] stated that the fondness for sweet substances gradually decreases as the age increases, which clearly explains the reason for more sweet likers in children compared to the mothers.

Till date, studies conducted on the taste status, compared it with many parameters such as the caries activity of an individual, taste preferences, obesity, and alcohol intake. Among them, studies comparing the taste status and caries activity in an individual outnumbered. All the

studies done comparing these two parameters showed a significant inverse relationship between the ability to taste PROP tester strip and caries activity. Among them, some landmark studies were those done by Lin,[2] Verma *et al*.,[21] and Rupesh and Nayak.[11] Hence, this led to another hypothesis that a supertaster will have a low caries activity when compared to that of a moderate and nontaster. In the present study [Table 1], the mean caries experience of both the supertaster mothers and children is very less compared to that of the moderate and nontaster mothers and children. The difference in the mean caries experience among the three taste groups of mothers and children were statistically significant, thereby supporting the above-mentioned hypothesis.

Drewnowski *et al*.[20] stated that many factors influence the development of food preferences in children, the first of which occur via intrauterine experience with flavors from the maternal diet and after birth with flavors of human milk. According to Alanzi *et al*.,[4] mothers might influence their children via their own food preferences, which may limit the foods offered to their children. Both these studies indirectly indicate that there might be a similarity in mother and child's taste status. However, studies comparing the mother and child's taste status are sparse [Table 2]. Out of the 211 supertaster mothers in the present study, 140 mothers had children with same taste status. However, the moderate and nontaster mothers also had a majority of their children with supertaster status, thereby clearly showing an insignificant relation between mother and child's taste status. However, further research should be carried out along with gene mapping to evaluate the relation.

Smith *et al*.[16] found a strong association between child's caries experience and their mothers *S. mutans* levels, maternal active caries, and maternal sugar consumption. They concluded that these three maternal risk indicators together can predict child's caries risk. It has indicated the fact that mothers oral health status is a good risk indicator for their children. Similarly, in the present study, when the mother and child's caries experience were correlated [Table 3 and Graph 1] a weak positive linear relationship was observed ($P = 0.004$), which means if one variable changes, the other variable will also change in the same direction.

Alanzi *et al*.[4] stated that it is possible that a mother's taste preference may influence what the child is fed and therefore may influence the caries risk of children. They found that the prevalence of dental caries in 2–3 years children was significantly greater in children of mothers who could not taste the PROP tester strips. Similarly, in the present study, when the correlation between mother's taste status and children's caries experience was evaluated [Table 4], the mean caries experience (def scores) of the children of supertaster mothers was less when compared to children of moderate taster mothers and nontaster mothers. However, the difference between the scores was not statistically significant. Thus, the present study could successfully prove the hypothesis pertaining to taste perception and caries experience in both mother and children.

The variables such as racial, socioeconomic, geographic distribution of the participating subjects, dental caries risk, and protective factors (e.g., fluoridated drinking water, saliva flow rate) are certain limitations that could not be controlled and might influence the results. Furthermore, children included in this investigation were from low socioeconomic background and restricted to a small geographic area, thus the results cannot be generalized. Thus, future studies with a larger sample size and a diverse ethnicity/racial background are recommended.

Conclusion

The conclusions drawn from the present study are:

1. The hypothesis which was tested regarding taste perception and caries experience was found to be true, with a strong inverse correlation between the ability to taste the bitterness of PROP tester strip and the caries experience
2. There was no correlation between the taste perception of the mother and their child
3. A weak-positive correlation was noticed with regard to caries experience among mothers and children
4. There is a positive correlation between mother's taste perception and their child's caries experience which was not statistically significant.

The results ascertained that the PROP strips can be used as a risk indicator. The PROP sensitivity test can be a valuable tool in the future to assess the inherent genetic sensitivity of a person for dietary preferences.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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