

Sweet Taste Perception and Dental Caries Experience among Preschool Children: A Critical review

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Abstract

Aim: The review aimed to analyze the relationship between sweet taste perception and dental caries among preschool children. **Methodology:** A literature search was conducted using PubMed, CINAHL, Dentistry, and Oral Sciences Source, and SCOPUS databases using the keywords “taste perception,” “sweet taste,” “dental caries,” and “dental decay.” The selection process involves two cycles. The inclusion criteria are documents that reported; sweet taste perception, dental caries experience, preschool children and written in English, and the exclusion criteria are; adults, review articles, letters to the editor, and case reports. The Newcastle Ottawa scale used for the quality analysis of the included studies.

Results: 344 titles and abstracts were retrieved during the initial search. Upon screening and exclusion, only three articles were eligible for final analysis. The included studies were conducted in the United States of America, Brazil, and India, with sample sizes ranging from 38 to 191 children. Two studies were conducted in dental clinic settings, while one was in an educational center. Among the three studies, two studies achieved unsatisfactory scores, and one study with achieved a good score.

Conclusions: Sweet taste perception and preference contribute to ECC. However, other important factors should be explored to employ various approaches to combat this disease.

Keywords: Sweet taste, dental caries, preschool children, primary dentition, diet

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1. Introduction

Early childhood caries (ECC) is defined as the presence of one or more decayed (non cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child 71 months of age or younger [1]. It is one of the most common oral diseases that afflict children globally. In its latest implementation manual, World Health Organization (WHO) recommended ending childhood dental caries, claiming that ECC is a highly prevalent global disease that affects more than 530 million children worldwide [2,3]. Figuratively, this shows how serious the problem is, considering that this disease is preventable.

The complex interrelation between genetic predisposition, oral bacteria colonization, and poor dietary habits has made ECC a multifactorial disease. One of the pivotal risk factors leading to ECC is frequent sugar consumption, which is

closely linked to individual taste perception. This is controversial as taste perception is different from one individual to another, depending on the taste sensitivity, and is considered a timeless element as it remains intact with age [4]. Meanwhile, taste sensitivity and taste perception certainly influence the taste preference of individuals. Sweet taste preference in children, particularly, is said to be at a high level because of several factors. Paglia et al. [5] claimed that sweet taste preference starts early in life, remains throughout childhood, and declines during mid adolescents. Hence, it is essential to expose the different flavors, especially healthy ones, to ensure easier food acceptance. Another study found a significant relationship between increased caries risk and frequent sugary drinks consumption [6]. On a side note, other factors, including maternal oral behavior, mother’s taste sensitivity, and children’s guardians such as grandparents, must be studied extensively to get a clear picture of how it contributes to the high ECC incidence

rate. The purpose of the manuscript was to identify the literature gap through a preliminary review of existing literature" on preschoolers' sweet taste perception, preference, and dental caries.

2. Methodology

A comprehensive literature search was conducted using various combinations of the keywords including "taste perception," "sweet taste," "dental caries," and "dental decay" through PubMed, CINAHL, Dentistry and Oral Sciences Source, and SCOPUS databases. The search included all studies published from the database's inception to October 2019. The selection was conducted in two cycles. The first cycle involved screening of title and abstract based on initial results from four databases. Included titles and abstracts from the first cycle were subjected to a full article review in the second cycle. In case of disagreement regarding incorporated documents, authors reached a consensus through discussion. This preliminary review included document sets that reported sweet taste perception, dental caries experience, preschool children, and language in the English language. Studies involving adults, review articles, letters to editors, and case reports were excluded from the analysis. Two independent examiners (NA and TM) were involved in the search, and one investigator (AF) took part in solving the disagreement between the two examiners. The interexaminer reliability (Kappa -0.92) and intra examiner reliability were 0.92 and 0.84 respectively. The process in the present paper was performed following the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) Guideline [7]. The details on retrieved, excluded and included documents were summarized in Figure 1. The finally available documents were graded using the "Newcastle-Ottawa Scale" (NOS). The quality assessment involves unsatisfactory (0- 4 points), good (5-6 points), sound (7-8 points), or very good (9-10 points) [8].

3. Result

Our initial search strategy retrieved a total of 344 titles. Only 88 documents were eligible for further analysis upon the first screening cycle. Following duplication removal, the remaining 43 papers were subjected to complete article analysis in the second cycle to assess their relevance based on inclusion and exclusion criteria. After the selection process, only three articles were qualified for final analysis [Table 1]. These three studies were reported the United States of America, Brazil, and India respectively [9-11]. The sample size of the included studies ranges from 38 to 191 children [9-11]. The study setting involved was the dental clinic [9,11] and educational center [10]. The age of children ranges from two- to six years old. Thirty-eight preschool children aged 2 to 3 years and their mothers

were involved in the American study [9]. While 191 children aged 4 to 5 years were involved in the Brazilian study [10], 119 children from 36 to 71 months were recruited in the Indian study [11]. In the American study [9], participants received clinical examinations, and mothers received a PROP test to assess their mother's taste perception. Whereas Sweet Preference Inventory was used to evaluate the taste perception used in the Brazilian study [10], the Indian study [11] used the PROP sensitivity test to assess the inherent genetic ability to taste perception. Nonetheless, due to the variation in age range and methodologies, a meta-analysis of the data was not performed. The NOS was used for the quality analysis of available studies. Among them, two studies [10,11] were considered unsatisfactory scores (4 stars), and the American study [9] achieved a sound score (7 stars). The quality analysis of the finally available studies was summarized in Table 2.

4. Discussion

Only three papers [9-11] are available in the published literature on sweet perceptions and ECC among children. Porcelli et al. [10] reported no significant correlation between sweet taste preference and dental caries. They evaluated the taste preference using the modified Sweet Preference Inventory (SPI) test, where the children must drink different concentrations of sugared solutions and choose the most palatable one. Despite the unusual finding, they recorded a high pattern of sweet liking among the children as most of them (67.5%) chose the first two concentrated solutions as their favorite. Furthermore, these children also had high caries occurrence. Another report [12] mentioned that food purchasing is influenced by environmental, personal, psychological, and socioeconomic factors. They added institutional influence as one of the determinants. It should be highlighted that preschoolers spend most of their time in school. Thus it is safe to claim that food served by the institution is potentially accountable for the high rate of dental caries occurrence [10].

Porcelli et al. [10] also claimed that the lack of connection between the studied variables was due to the high common sweetness preference. As highlighted by Rose et al. [13], the more widespread a causative factor, the less it explains the distribution of the disease. They suggested that this situation could have occurred in their study, hence the unlikely result. Admittedly, childhood is a crucial time where they learn how to eat and develop their food preferences. Due to this fact, the family plays a significant role in guiding their children throughout the process. Authors also claimed that mothers greatly influence children's food preferences [14, 15]. This statement aligned with findings by Alanzi et al. [9], who mentioned that parental influence, especially maternal influence, largely contributes to children's food choices.

4.1. Mothers' taste sensitivity on children's caries status and PROP test as taste sensitivity marker.

PROP (6-n-propylthiouracil) is a tool that helps in determining the genetic sensitivity levels to bitter and sweet tastes. Since there is insufficient dental research regarding a mother's taste perception and dental caries experience in children, Alanzi and colleagues [9] stressed that food preference is genetically related (taste-wise). Thus a PROP screening test was performed to evaluate the mother's taste sensitivity. Surprisingly, there was a positive relationship between a mother's PROP test result and dental caries experience [9]. An earlier study explained that the drug's taste differs according to the individual; some taste bitterness while others barely taste anything [16]. Green et al. [17] classified the tasters based on PROP test values, including non-tasters (>12), medium tasters (12-60), and supertasters (>60). A recent study stated that most PROP non-tasters were sweet likers who prefer sweet and strong-tasting food. They also mentioned that mothers who are PROP non-tasters tend to give their children more sweets as they would consume more sugar compared to supertaster mothers [18]. Hence, this situation leads to the development of early childhood caries. In addition, Alanzi et al. [9] emphasized that a PROP screening test is a reliable tool for identifying caries risk in young children.

Pidamale et al. [11] successfully proved that the PROP test was a useful diagnostic tool to determine the genetic taste sensitivity level towards bitterness, as per the test conducted on children. In contrast to an American study [9], they had a different target group since they aimed to find the connection between the PROP test result with dental caries experience among preschoolers aged 36 to 71 months. Interestingly, the authors modeled the methods by using facial expressions as a determinant to classify the children into the taster or non-taster group rather than using the general Labeled Magnitude Scale (gLMS). Their study explained that children are still developing their psyche and undergoing behavioral changes at a young age; thus, using the gLMS is unsuitable and could produce inaccurate results [11]. The findings in this study showed the unique link between the PROP test status with dental caries among preschoolers, corroborating with Alanzi et al. [9] despite testing different age groups. Pidamale et al. [11] reported that PROP tasters are sweet dislikers with decreased caries risk and oral sensations that are too intense to accept intense bitter or sweet substances, making them less prone to tooth decay. In addition, they highlighted the relationship between the findings and the number of distributions of the fungiform papillae; genetic variation in the taste ability is related to the fungiform papillae, and tasters have more papillae than non-tasters [11].

4.2. The increasing trend of sugar consumption, accessibility of sugary food, and dental caries

Another interesting note that Porcelli et al. [10] underlined is the soaring trend of sugary food liking among preschoolers in Brazil. They described that this finding could reflect Brazil's economic and cultural influence on the sugar industry on a broader spectrum. According to Brazil's first National Dietary Survey conducted in 2008 and 2009, 61% of Brazilians consumed sugar as more than 10% of their total energy intake [19]. This statistic provided insight into the Brazilian population's failure to adhere to the World Health Organization's (WHO) recommendation to consume sugar less than 5% of the total energy intake to prevent unhealthy weight gain and dental caries occurrence in children and adults [20].

Additionally, Porcelli et al. [10] reported a high incidence of dental caries (51.8%) among their subjects, indicating that more than half have dental caries. The pre-schoolers also had at least two teeth afflicted with caries on average, and a majority of the index accounted is from the decayed component. This value was slightly higher than the data from Alanzi et al. [9], wherein 55% of their subjects were caries-free. Porcelli et al. [10] stressed that the contributing factor to this data is the ease of accessing sugary food and drink. They further blamed the increasing trend of consuming sweetened beverages such as soft drinks or artificial juice that contributes to a high added sugar intake, thus reducing nutritious food intake. This cycle produces unwanted results, escalating the prevalence and risk of non-communicable diseases such as dental caries.

4.3. The older generation, oral behavior, and knowledge of dental caries

An important factor is grandparents' involvements in the children's dietary habits. In this context, authors discovered that children of non-taster mothers who live with their grandparents have higher dental caries experience than children living with their parents only [9]. At the same time, another claimed that the magnitude of dental caries occurrence among children living with grandparents is four-fold higher than those living without grandparents [21]. Various researchers [22-26] used different parameters to establish a relationship with early childhood caries; sweet taste perception has not been discussed in the literature. Although there was a similar pattern in the study reported by Porcelli et al. [10], their case involved older mothers whose children had the highest proportion of excess weight. This finding is unexpected as older women generally have more wisdom and knowledge to care for their children than young and inexperienced mothers. This statement suggests that the age group of the children's guardians affects their dietary

habits. Authors also agreed that the severity of children's caries is higher when their mothers have untreated dental caries [9, 27]. As a mother's oral health status is a significant risk indicator for the children's caries status, this aspect provides an insight into how maternal behavior towards oral care could prevent the children from early caries lesion [9].

4.4. Limitations of the studies

A Brazilian study by Porcelli et al. [10] disregarded an important variable that could better understand the results i.e., the analysis of food consumption, inadequate dietary practices, and oral health behaviors. Furthermore, the study lacked generalizability as it was only conducted in public schools and did not represent the population. The authors also emphasized that a few dental caries risks and protective factors such as saliva flow rate and fluoridated drinking water were not controlled. However, it is a significant contributing factor to dental caries [9]. On the other hand, an Indian study [11] stated that future studies should better understand the cariogenic bacteria's behavior in the oral environment and thoroughly understand the interplay between a person's genetic makeup and exposure to the environmental factor. These factors should be considered to examine caries risk better, outlining efficient preventive strategies. The perspective involves only three studies with 348 subjects aged below 6 years. This is a significantly less sample to draw any appropriate conclusions. These findings can be used to develop further reviews.

4.5. Recommendations

This paper explains the association between sweet perception and ECC among children below six years. There is scope to establish the relation between sweet perception and ECC. In the preliminary review, only three studies were available for the analysis which warrants further studies with a large sample size. Nonetheless, it could be presumed that the outcomes attained from the present preliminary review could not contemporaneous an accurate picture sweet taste perception and dental caries among children globally. In the future, additional studies are anticipated to distinguish the details of contributing factors of sweet taste perception and dental caries among school children.

5. Conclusion

In conclusion, taste perception and preference are directly related to dental caries but are not the only contributing factors to ECC prevalence. A multifaceted approach must be considered to investigate this matter as it involves a complex relationship between genetic predisposition, microbiological factors, dietary choice, and children's upbringing.

Author Contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

NA. and AF. were involved in data collection; NA, AF., TM. and MS were involved in analysis; AF, TM, and MS developed the concept; NA, AF., TM. and MS. wrote the first draft. NA, AF., TM. and MS. were involved in reviewing and editing the manuscript. All authors have read and agreed to the published version of the manuscript.

Ethical Approval

No ethical approval required for this review.

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Conflict Of Interest Statement

The author declare no conflicts of interest.

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Table 1: Studies selected for the preliminary review

Authors	Year	Country	Sample size	Age range	Conclusion
Pidamale et al.[11]	2012	India	119	3-6 years	A small sample of preschool children suggested a multi-factorial relationship between early childhood caries, taste perception, and streptococcus mutans levels
Alanzi et al. [9]	2013	United States of America	38	2-3 years	The prevalence of caries was significantly greater in children of mothers who couldn't taste the chemical 6-n-propylthiouracil.
Porcelli et al. [10]	2019	Brazil	191	4-5 years	The sweetness taste preference is neither associated with dental caries nor among excess weight and dental caries

Table 2: Quality of the studies, using a Newcastle-Ottawa Scale.

Study	Selection	Comparability	Exposure	Total score/9
Pidamale et al.[11]	**	*	*	4/9
Alanzi et al. [9]	****	**	*	7/9
Porcelli et al. [10]	**	*	*	4/9

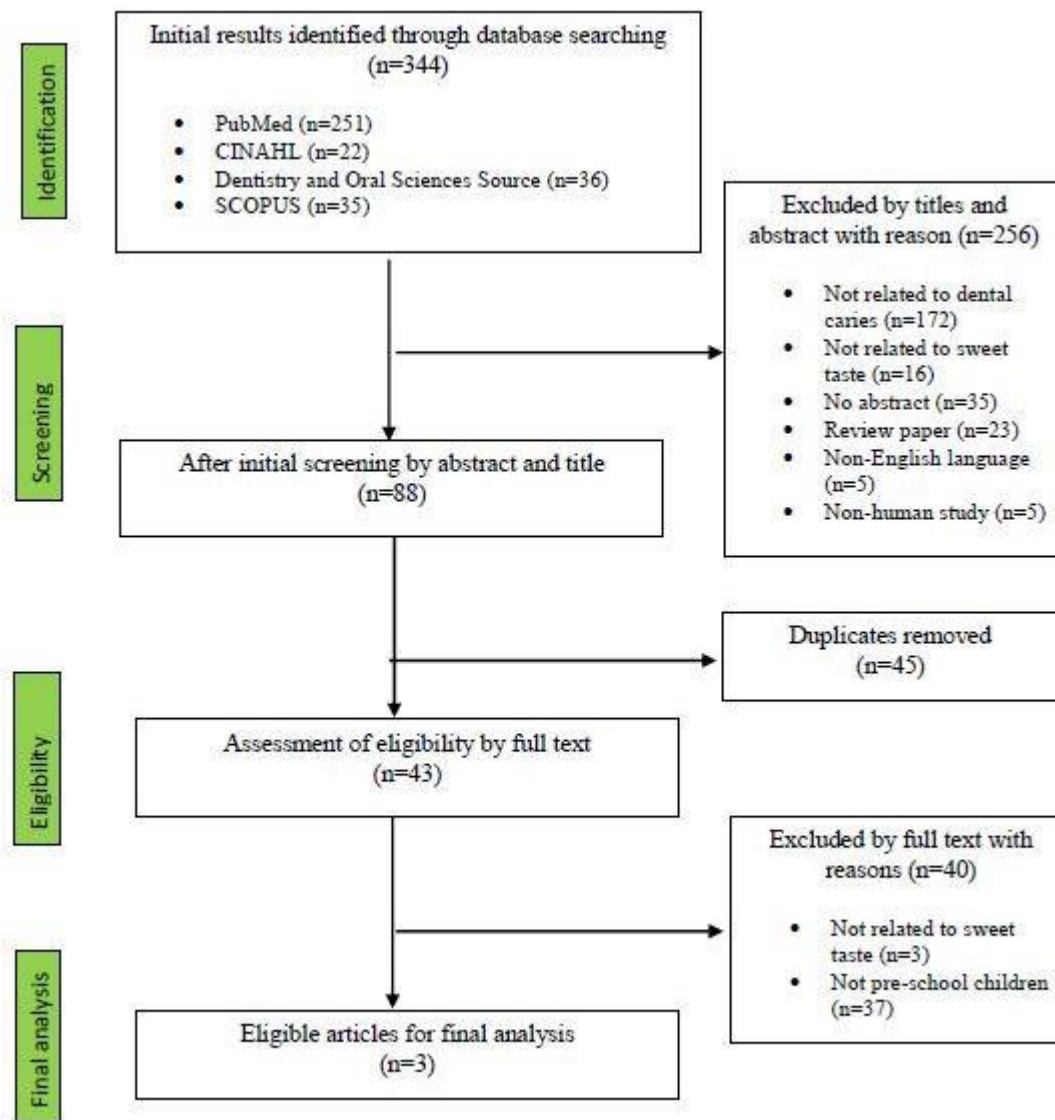


Figure 1: Flow diagram illustrating the number of studies screened and assessed for final analysis