# The Effect of Sweet Taste Perception on Dental Caries Experience in Relation to Age and Gender in Primary School Children

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# تأثير تحسس الطعم الحلو على تسوس الاسنان نسبة الى العمر والجنس في طلاب المدارس الابتدائية

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## Abstract

Objective: This study aims to investigate the impact of sweet taste perception (sweet taste threshold and preference) on dental caries experience in relation to age and gender among a sample of schoolchildren.

Materials and Methods: The research follows a cross-sectional observational design and includes 181 schoolchildren of both genders aged between 6 and 12 years from the Al-Risafa district of Baghdad city. The participants were divided into two age groups (6-8 and 9-12). Dental caries were assessed using the decayed, missing, and filled indices for primary and permanent teeth (dmfs, dmft, DMFS and DMFT). Additionally, the sweet taste threshold and sweet taste preference were measured for 60 participants whose parents provided their consent for these procedures.

Results: The study revealed a significant positive correlation between dental caries experience and sweet taste threshold among children aged 6-8 years. For permanent teeth, dental caries experience showed a significant correlation with sweet taste threshold specifically among females. Furthermore, sweet taste preference was significantly correlated with the decayed surface component of the DMFT index, regardless of age and gender.

Conclusion: The findings suggest that sweet taste perception is significantly associated with dental caries experience in school-aged children.

**Keywords: Sweet Taste Threshold; Sweet Taste Preference; Dental Caries; Schoolchildren; Iraq.**

## المستخلص

الهدف: دراسة تأثير تحسس المذاق الحلو على تسوس الاسنان في مجموعة من طلاب المرحلة الابتدائية.

المواد والطرق: تضمنت عينة البحث 181 طالبا من المرحلة الابتدائية من الذكور والاناث تتراوح اعمارهم بين ست و اثنتي عشر سنة ضمن قطاع الرصافة في العاصمة بغداد. تم قياس عتبة الطعم الحلو وكذلك التركيز المفضل لكل طالب ضمن العينة. كما تم فحص وقياس تسوس الاسنان لكل طالب.

الاستنتاج: وجدت الدراسة ان تحسس المذاق الحلو ذو صلة بتسوس الاسنان عند الاطفال.


**الكلمات المفتاحية: عتبة الطعم الحلو، تفضيل الطعم الحلو، طلاب المدارس الابتدائية، تسوس الاسنان، العراق.**

## Introduction

Dental caries is the most widespread non-communicable disease globally. Its development is closely linked to the consumption of sugar, which is metabolized by oral cavity bacteria, leading to the production of acids that cause tooth demineralization and dental caries (WHO, 2017). Sugar consumption can be influenced by various factors, including sweet taste perception.

The initial perception of sweetness occurs on the tongue, where ligands with a sweet taste stimulate taste cell receptors, triggering pleasurable sensations through G protein-mediated signaling in the brain (Mennella *et al*., 2016). Taste preferences for sweetness can change with age, as evidenced by studies using different sweeteners in a lab setting. Young children tend to prefer very sweet solutions more than adults, with taste preferences becoming more adult-like during puberty. Adolescents generally favor sweeter solutions compared to adults, and younger children prefer higher concentrations of sucrose in solutions compared to adolescents (Drewnowski *et al*., 2012). This heightened demand for sucrose in childhood might be attributed to rapid physical growth, as evidenced by higher levels of biomarkers associated with bone growth in adolescents with a higher preference for sweet taste (Forestell, 2017).

Previous research has explored the connection between sweet taste perception and dental caries. A study by Jurczak *et al*.2020) ٩) revealed a significant positive correlation between preschool children's perception of sweetness and the incidence and severity of dental caries. Lower sucrose sensitivity was associated with higher mean dmft (decayed, missing, and filled primary teeth) scores, indicating that the development of children's sweet taste threshold is influenced by their sugar intake. An increase in sweet

taste sensitivity due to sugar consumption could lead to higher sugar intake and, subsequently, an increased risk of dental caries (Jurczak *et al*., 2020).

Studies discussing taste perception have been previously conducted in Iraq (Zaidan and Al-Omary,2009; Alsafi And Diab, 2017; Rasool and Diab 2022a; Rasool and Diab, 2022b). However, these studies are limited in number. In addition, most of these studies were conducted on adults or medically compromised individuals.

The objective of this study is to investigate the relationship among school children in Iraq. The study hypothesizes that sweet taste perception affects dental caries through its influence on the intake of sugar-containing foods.

## Materials and Methods

### Study Sample and Design

The study group comprised schoolchildren aged between 6 and 12 years from Al-Risafa district in Baghdad, including both genders. The sampling process was conducted in two stages. Initially, the researcher randomly selected five different schools, but only three schools agreed to participate in the study. Subsequently, students were randomly chosen from each school, ensuring the sample was representative of the various ages within the study. The sample size consisted of 70 students from the first school, 64 from the second school, and 50 students from the third school.

Official approval was obtained from Al-Risafa Directorate of Education before commencing the study. Parents of the participating children were provided with a consent form to obtain their permission for participation in the study.

## Dental Examination

The researcher recorded the dental caries experience of the participants using decayed, missing, and filled indices for primary and permanent teeth (dmfs, dmft, DMFS and DMFT). Inter and intra-examiner calibration was performed prior to the study. The dental examination was conducted using a disposable plane mouth mirror and dental explorer. The diagnosis of dental caries followed the criteria outlined by Manjie et al. (1989). The examination took place in the schoolchildren's classrooms with sufficient daylight, ensuring maximum illumination for accurate assessments.

## Sweet Taste Perception Test

The solutions for the sweet taste perception test were prepared one day before the scheduled visit and had varying concentrations as follows (Chung *et al*., 1984):

1. 0.263 mmol/L
2. 0.646 mmol/L
3. 2.375 mmol/L
4. 7.128 mmol/L
5. 21.385 mmol/L
6. 48.613 mmol/L

The solutions were refrigerated until the examination day and then brought to room temperature. During the test, students were called to the room, and five milliliters of each solution were measured using a disposable plastic syringe and put in numbered disposable plastic cups (1 to 6) placed on a desk in front of each participant. The cups were offered to each participant in ascending order of concentration, starting from the lowest. Each participant held the solution in their mouth for a minute, and then spat it out

(whole mouth testing method). The researcher asked each participant whether they sensed sweetness in each solution after tasting it to determine sweet taste threshold. After tasting all solutions, sweet taste preference was determined by asking each participant to indicate which solution they liked the most.

## Statistical Analysis

The data were analyzed using the Statistical Package for Social Science (SPSS version -22, Chicago, Illinois, USA). The statistical analysis was divided into two categories:

1. Descriptive Analysis:
    A. For qualitative variables, frequency and percentage were used, while mean and Standard Error (SE) were used for quantitative variables.
    B. Graphs, including simple and cluster bar charts, were employed.
2. Inferential Analysis:
    A. Independent Sample T test: This parametric test was used to compare the difference between two groups.
    B. Shapiro-Wilk test: Used to assess the normal distribution of quantitative variables.
    C. Paired T test: Employed to test the difference between two related points (two measurements by one subject or two subjects for one measurement).
    D. Pearson correlation: A parametric test used to assess the linear correlation between two quantitative variables.

E. Fisher exact: This test determined the association of distribution between two qualitative variables when the expected cell count was less than 5 and more than 20%.

The significance level (p-value) was set as follows: Not significant ($P > 0.05$) and Significant ($P < 0.05$).

### Ethical Approval

An ethical approval was obtained from the ethical approval committee, college of dentistry/ university of Baghdad to perform this study.

## Conflict of Interest:

The authors declare that there are no conflict of interest regarding this article.

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## Results

### Study Subjects

A total of 181 students from primary schools between the ages of 6 and 12 were included in the sample. Out of which 101 (55.8%) were males and 80 (44.2%) were females. The distribution of the sample is shown in Figure 1. The sample was divided into two age groups, with a higher percentage of males (55.8%) than females (44.2%), as indicated in the figure below.

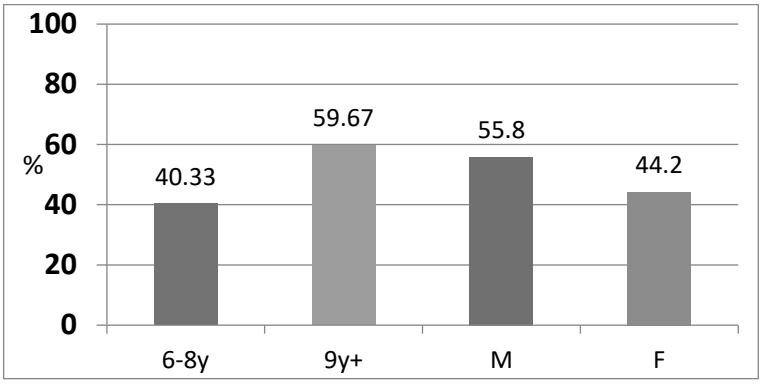


**Figure 1, Distribution of the subjects by age and gender.**

## Dental caries experience and sweet taste parameters

The correlation between primary caries experience, sweet threshold, and sweet preference by age and gender is shown in Table 1. A significant positive correlation was noted between both the dmfs index and its component ds, and sweet taste preference in the 6-8 age group.

**Table 1. Correlation between primary caries experience and sweet threshold and sweet preference by age and gender.**

| Variables. | Categories. | | Sweet taste threshold | | Sweet taste preference | |
|---|---|---|---|---|---|---|
| | | | r | p | r | P |
| Age (years) | 6-8 | Ds | 0.248 | 0.266 | 0.437 | 0.042* |
| | | Ms | 0.036 | 0.874 | 0.060 | 0.790 |
| | | Fs | 0.077 | 0.734 | 0.107 | 0.636 |
| | | Dmfs | 0.267 | 0.230 | 0.466 | 0.029* |
| | | Dmft | 0.299 | 0.176 | 0.381 | 0.080 |
| | 9+ | Ds | 0.161 | 0.333 | 0.037 | 0.825 |
| | | Ms | 0.022 | 0.895 | 0.236 | 0.153 |
| | | Fs | 0.017 | 0.917 | 0.028 | 0.870 |
| | | Dmfs | 0.148 | 0.374 | 0.044 | 0.793 |
| | | Dmft | 0.213 | 0.200 | 0.114 | 0.494 |
| Gender | M | Ds | 0.018 | 0.920 | 0.103 | 0.568 |
| | | Ms | 0.051 | 0.779 | 0.229 | 0.199 |
| | | Fs | 0.059 | 0.744 | 0.133 | 0.461 |
| | | Dmfs | 0.005 | 0.978 | 0.040 | 0.826 |
| | | Dmft | 0.058 | 0.748 | 0.051 | 0.780 |
| | F | Ds | 0.080 | 0.692 | 0.075 | 0.709 |
| | | Ms | 0.043 | 0.830 | 0.135 | 0.502 |
| | | Fs | 0.026 | 0.898 | 0.029 | 0.884 |
| | | Dmfs | 0.077 | 0.702 | 0.105 | 0.604 |
| | | Dmft | 0.030 | 0.882 | 0.082 | 0.685 |
| Total | | Ds | 0.050 | 0.703 | 0.079 | 0.548 |
| | | Ms | 0.005 | 0.969 | 0.115 | 0.384 |
| | | Fs | 0.038 | 0.773 | 0.054 | 0.683 |
| | | Dmfs | 0.043 | 0.744 | 0.049 | 0.709 |
| | | Dmft | 0.106 | 0.420 | 0.074 | 0.572 |

*significant at P <0.05

Table 2 presents the correlation between permanent caries experience and sweet threshold and sweet preference by age and gender. The correlation between sweet taste threshold and dental caries experience was weak positive but non-significant except for a significant positive correlation between Ds component of the DMFS index and sweet taste preference in females.

As for sweet taste preference, a moderate significant positive correlation found between sweet taste preference and DS component (Decayed surfaces of permanent teeth) of DMFS index in 9-12 age group.

In addition to that, sweet taste preference was found to be significantly correlated with Ds component of the DMFS index regardless of age and gender.

**Table 2. Correlation between permanent caries experience and sweet threshold and sweet preference by age and gender.**

| Variables. | Categories. r | | Sweet taste threshold | | Sweet taste preference | |
|---|---|---|---|---|---|---|
| | | | p | r | P | |
| Age | 6-8 | DS | 0.032 | 0.886 | 0.113 | 0.615 |
| | | DMFS | 0.032 | 0.886 | 0.113 | 0.615 |
| | | DMFT | 0.077 | 0.734 | 0.065 | 0.774 |
| | 9+ | DS | 0.129 | 0.439 | 0.492 | 0.002* |
| | | FS | 0.280 | 0.088 | 0.156 | 0.349 |
| | | DMFS | 0.074 | 0.661 | 0.197 | 0.237 |
| | | DMFT | 0.040 | 0.812 | 0.081 | 0.628 |
| Gender | M | DS | 0.083 | 0.645 | 0.003 | 0.985 |
| | | FS | 0.016 | 0.928 | 0.094 | 0.601 |
| | | DMFS | 0.073 | 0.685 | 0.039 | 0.830 |
| | | DMFT | 0.011 | 0.951 | 0.095 | 0.601 |
| | F | DS | 0.471 | 0.013 | 0.532 | 0.004* |
| | | FS | 0.027 | 0.894 | 0.174 | 0.385 |
| | | DMFS | 0.283 | 0.153 | 0.186 | 0.352 |
| | | DMFT | 0.259 | 0.192 | 0.091 | 0.651 |
| Total | | DS | 0.115 | 0.382 | 0.311 | 0.016* |
| | | FS | 0.181 | 0.166 | 0.087 | 0.507 |
| | | DMFS | 0.009 | 0.947 | 0.088 | 0.504 |
| | | DMFT | 0.011 | 0.932 | 0.006 | 0.963 |

***significant at p <0.05**

## Discussion

Dental caries is the most common disease affecting children all over the world (Munther, 2020). The present study was conducted with primary schoolchildren in Baghdad city to investigate the impact of sweet taste perception on dental caries experience. The age range of 6 to 12 years was chosen as sugar consumption tends to increase in this group, and primary schoolchildren are more cooperative and better understand research methodologies compared to younger children.

The study revealed a significant positive correlation between sweet taste preference and dental caries experience in both primary and permanent teeth. This finding is consistent with a prior study conducted in Iraq, which assessed sweet preference and dental caries in 4,152 male and female children of various ages using the DMFT index (Jamel *et al*., 1997).

However, the results of this study differ from those of a multinational study conducted in Saudi Arabia, Mexico, and Italy (Ashi *et al*., 2017), which found no significant correlation between sweet taste preference and dental caries experience. Similar results were also observed in other studies, such as Furquim *et al*.'s study (2010) on 12-year-old children, and two studies conducted in Brazil among 5 to 12-year-old children (Cagnani *et al*., 2014) and 4 and 5-year-old children (Porcelli *et al*., 2019).

The increase in dental caries experience observed in the current study can be attributed to the higher intake of sugar-containing foods due to increased sweet preference, as sugar is a known causative factor for dental caries. The divergent results across different studies may be attributed to variations in sweet preference testing, participant age, racial differences, and other factors affecting dental caries experience, including mineral

content of teeth, fluoride exposure, and patterns of sugar consumption, oral hygiene habits, and socioeconomic factors.

Interestingly, the study found a significant correlation between sweet taste threshold and dental caries in permanent teeth, but this association was only observed in females in a positive direction. This might be explained by the assumption that an increased threshold for sweet taste could lead to higher sugar intake, subsequently resulting in more dental caries. Additionally, the female predilection could be attributed to the higher susceptibility of females to dental caries due to the earlier eruption of permanent teeth. These results align with a study by Jurczak *et al*. (2020), which found a positive correlation between sweet taste perception and dental caries in preschool children. However, a study in Iraq by Rasool (2021) did not find a significant association between sweet taste threshold and dental caries among diabetic and non-diabetic groups, suggesting a need for further research to explore the relationship between increased sweet taste threshold and dental caries experience.

## Conclusion

In conclusion, the study demonstrated a significant correlation between dental caries experience (represented by the number of decayed surfaces in primary and permanent teeth) and both sweet taste preference and sweet taste threshold.

### Suggestions

Factors influencing dental caries experience are complex and further investigations are needed to better understand this relationship.

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