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ORIGINAL RESEARCH

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Does parental feeding style affect tooth decay in preschool children?

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Abstract

Background: Diet is a key risk factor in the development of dental caries, and parents' nutritional attitudes can shape children's eating behaviors. This study aimed to evaluate the association between parental eating behaviors, feeding styles, and dental caries in preschool children. **Methods**: The study included 376 children aged 3–6 years. Participants were classified into four groups according to their maximum Caries Assessment Spectrum and Treatment (CAST) score: healthy/pre-morbidity (scores 0–3), morbidity (scores 4–5), severe morbidity (scores 6–7), and mortality (score 8). Parents completed the Child Eating Behavior Questionnaire (CEBQ) and the Parental Feeding Style Questionnaire (PFSQ). Socioeconomic status was assessed using the Family Affluence Scale. **Results**: Higher CAST scores were significantly associated with lower socioeconomic status and parental education levels ($p < 0.001$). The proportion of children in the mortality stage increased with more frequent junk food consumption ($p < 0.001$). Significant differences across dental caries stages were observed in the CEBQ subscales of Desire to Drink ($p = 0.002$), Slow Eating ($p = 0.001$), Emotional Undereating ($p = 0.008$), and Food Fussiness ($p = 0.001$). Comparisons between morbidity stages showed statistically significant differences in instrumental ($p = 0.005$) and emotional feeding styles ($p = 0.003$), with the highest values observed in the mortality group. Linear regression analysis evaluating the effects of CEBQ and PFSQ subscales on the maximum CAST score demonstrated a statistically significant model ($F = 7.437$; $p < 0.001$). **Conclusions**: Children's eating behaviors and parental feeding styles appear to influence both the presence and severity of dental caries during the preschool period. Evaluation of dietary behaviors may enhance understanding of the multifactorial etiology of dental caries and support the promotion of healthy eating habits in early childhood.

Keywords

Dental caries; Children's eating behavior; Parental feeding style; Caries assessment spectrum and treatment; Family affluence scale

1. Introduction

Early childhood caries remains a highly prevalent disease worldwide and is more common in developing countries [1, 2]. In recent years, more than 70% of children aged <6 years in Turkey have been affected by tooth decay [3].

The development of dental caries is multifactorial, and diet is an important risk factor [4]. Food choices and feeding practices are related to diet, and certain eating and feeding behaviors in children may be associated with caries development [5, 6]. In addition, parents play an important role in determining young children's food preferences. Their attitudes towards diet are associated with the diet and nutrition provided to their children. Parents can influence their children's eating behaviors through food parenting practices, which are food-specific behaviors or actions that can influence their children's attitudes or behaviors [7, 8]. Various questionnaires in the literature assess children's eating behaviors and food-related parenting practices. Among these, the Children's Eating Behavior Questionnaire (CEBQ) is used to evaluate children's eating behavior, and the Parental Feeding Style Questionnaire (PFSQ) is used to evaluate parents' feeding styles for their children, which are valid and comprehensive tools answered by parents [9, 10].

Data exploring the relationship between parental feeding styles, children's eating behaviors, and caries severity across different stages—particularly in preschool children from developing countries—remain limited. By utilizing the CAST index to categorize caries severity and combining validated behavioral tools (CEBQ and PFSQ), the present study was designed to address this gap in a Turkish preschool population. Several studies have focused on eating behavior disorders (such as obesity, anorexia nervosa, and bulimia nervosa); however, studies evaluating the effects of eating behaviors

in the preschool period on dental caries are limited. The primary objective of this study was to evaluate the association between dental caries severity, defined as the maximum CAST score (primary outcome), and children's eating behaviors and parental feeding styles, assessed using the CEBQ and PFSQ questionnaires (primary explanatory variables), in preschool children.

The secondary objective was to examine the relationship between dental caries severity and sociodemographic factors, including socioeconomic status and parental education levels.

2. Materials and methods

2.1 Protocol

This study was conducted at the Department of Pediatric Dentistry, Faculty of Dentistry, Erciyes University between January and December 2023. The study was approved by the Erciyes University Clinical Research Ethics Committee (2023/16). The procedures used in this study adhere to the tenets of the Declaration of Helsinki. Informed consent was obtained from all individual participants included in the study.

2.2 Eligibility criteria

Healthy children aged 3–6 years were included, while children with serious medical conditions or developmental disorders such as Down syndrome, heart disease, and mental retardation, who were on chronic medication, had a history of dental trauma, anomalies of the enamel and dentin, and were unable to comply with dental examinations were excluded from the study. Parents who could not understand or answer the questions because of a medical condition, did not speak Turkish fluently, or did not agree to participate in the study were not included. Participation in this study was voluntary. All parents were informed about the study, and informed consent was obtained.

2.3 Sample selection

The sample size of the study was calculated based on the primary outcome variable, namely the "Enjoyment of Food" subscale of the Children's Eating Behaviour Questionnaire (CEBQ), as reported by Nembhwani *et al.* [11]. Power analysis was performed using G*Power software (version 3.1.9.6; Heinrich-Heine-Universität Düsseldorf, Düsseldorf, NRW, Germany) with a confidence level of 95% ($1 - \alpha$), a test power of 95% ($1 - \beta$), and an effect size of 0.49. The analysis indicated that a minimum of 90 participants per group was required. Although the final analyses involved multiple CAST severity categories, the sample size estimation was conducted to ensure adequate statistical power to detect clinically meaningful differences in eating behavior scores across different caries severity levels. The calculated sample size was therefore considered sufficient for subsequent non-parametric comparisons.

2.4 Clinical examination

The children included in the study were examined under a light source using a mouth mirror and a blunt probe. The current caries status was assessed using the Caries Assessment Spectrum and Treatment (CAST) index by two pediatric dentist researchers [12]. Before the examination, the two researchers were informed about the CAST index by an experienced pediatric dentist, and the index was evaluated in detail. Subsequently, a study was conducted on 30 children who were not included in the study to standardize the examination and test the calibration between researchers. The examination results were compared to those of an experienced pediatric dentist in the field. The kappa test was performed on a tooth-by-tooth basis to verify the calibration of the researchers. The kappa coefficients ranged from 0.76 to 0.82.

During the examination, all tooth surfaces were dried, and the CAST code for each tooth was recorded according to the CAST index [13]. Participants were categorized into four groups by dividing them into CAST categories according to their maximum CAST scores (codes 0–8): healthy/premorbidity (maximum CAST score of 0, 1, 2 and 3), morbidity (maximum CAST scores of 4 and 5), severe morbidity (maximum CAST scores of 6 and 7), and mortality (maximum CAST score of 8).

After the dental examination, children's sociodemographic data (age and sex), frequency of junk food snacking and oral hygiene habits, and parents' socioeconomic status and educational level were recorded. The Family Affluence Scale (FAS) was used to assess the socioeconomic status [14, 15]. The scale consists of four items: ("Do you have a car at home?" No = 0; one = 1; yes, more than two = 2; "How many computers do you have?" No = 0; one = 1, two = 2, more than two = 3; "Does the child have her/his own bedroom?" No = 0, yes = 1; "In the past 12 months, how many times did you travel holidays?" No = 0, once = 1, twice = 2, more than twice = 3). The total FAS score was calculated by adding the scores of the answers. Score of 0–2 indicates low, score 3–5 indicates medium, and score 6–9 indicates high socioeconomic status.

2.5 Questionnaire

Children's eating behavior was assessed using the Turkish version of the CEBQ questionnaire [16]. The questionnaire consists of eight subscales and 35 questions. Four of the eight subscales indicate interest in food: food responsiveness (FR), enjoyment of food (EF), emotional overeating (EO), and desire to drink (DD). The four subscales indicate a lack of interest in food: satiety responsiveness (SR), slowness in eating (SE), emotional undereating (EUE), and food fussiness (FF). Parents' feeding styles towards their children were assessed using the Turkish version of the PFSQ [17]. The questionnaire consists of four factors and 27 questions: Factor 1: control overeating (C); Factor 2: instrumental feeding (I); Factor 3: encouragement to eat (EN); and Factor 4: emotional feeding (EM). Each item in the CEBQ and PFSQ is answered on a 5-point Likert scale: never (1), rarely (2), sometimes (3), often (4), and always (5). The mean value and standard deviation of each subscale were calculated by summing the scores of the questions belonging to the same subscale.

All questionnaires were self-administered by the parents. No face-to-face or structured interviews were conducted. Parents completed the questionnaires independently in the clinic

setting. A researcher was present only to clarify any questions regarding the items, without influencing the responses.

2.6 Statistical analysis

The data were recorded using Microsoft Excel (Microsoft Office 365, Microsoft, Redmond, WA, USA). Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) (version 24.0; IBM Inc., Armonk, NY, USA). For numerical data, mean, standard deviation (SD), median, and interquartile range (IQR; 25%/75%) values were provided, whereas for categorical data, frequency and percentage values were provided. Homogeneity analysis was evaluated using Levene's test, and normality was assessed using the Shapiro-Wilk test. Pearson's Chi-Square test was used to analyze the categorical data, and multiple comparisons were made using the Bonferroni-corrected Z test. The Kruskal-Wallis test was used for comparisons of parameters with three or more subgroups that did not show normal distribution, and the Mann-Whitney U test was used for pairwise comparisons. Multiple linear regression analysis was performed with the maximum CAST score as the dependent variable. Eating behavior and parental feeding style subscale scores were included as independent variables, and junk food consumption, parental education level, and socioeconomic status were entered into the model as covariates to control for potential confounding effects. Multicollinearity was assessed using variance inflation factors (VIF). Statistical significance was set at $p < 0.05$ for all comparisons.

3. Results

A total of 412 children and their parents were evaluated for inclusion in the study, of which 22 parents refused to participate in the study, and 14 parents had missing data in their questionnaires. Thus, 376 children (210 girls and 166 boys) were included in the study.

General information on the children and parents participating in the study (age, sex, oral hygiene habits, socioeconomic status, and educational level), as well as the CAST categories of the children are shown in Table 1. While high CAST scores were associated with low socioeconomic status and parental

TABLE 1. Demographic characteristics of the children and factors associated with dental caries.

CAST categories	Healthy/Pre-morbidity 99 (26.3)	Morbidity 90 (23.9)	Severe Morbidity 95 (25.3)	Mortality 92 (24.5)	Total 376	p values*
Age	4.71 ± 1.15 yr (Female); 4.54 ± 1.09 yr (Male)					
Gender						
Female	60 (60.6)	52 (57.8)	48 (50.5)	50 (54.4)	210 (55.8)	0.528
Male	39 (39.4)	38 (42.2)	47 (49.5)	42 (45.7)	166 (44.2)	
Socioeconomic Status						
Low	22 (22.2)^{a}	35 (38.9)^{a,b}	47 (49.5)^{b}	42 (45.7)^{b}	146 (38.8)	
Middle	43 (43.4)	41 (45.6)	44 (46.3)	45 (48.9)	173 (46.0)	<0.001
High	34 (34.3)^{a}	14 (15.6)^{b}	4 (4.2)^{b}	5 (5.4)^{b}	57 (15.2)	
Education Level						
Primary school	8 (8.1)^{a}	20 (22.2)^{b}	35 (36.8)^{b}	28 (30.4)^{b}	91 (24.2)	
Highschool	16 (16.2)^{a}	29 (32.2)^{a,b}	26 (27.4)^{a,b}	36 (39.1)^{b}	107 (28.5)	<0.001
University	75 (75.8)^{a}	41 (45.6)^{b}	34 (35.8)^{b}	28 (30.4)^{b}	178 (47.3)	
Junk Food Consumption						
None/1 day a week	33 (33.3)^{a}	11 (12.2)^{b}	8 (8.4)^{b}	13 (14.1)^{b}	65 (17.3)	
2–3 days a week	32 (32.3)	29 (32.2)	32 (33.7)	30 (32.6)	123 (32.7)	<0.001
More than four days a week	34 (34.3)^{a}	50 (55.6)^{b}	55 (57.9)^{b}	49 (53.3)^{a,b}	188 (50.0)	
Tooth Brushing Frequency						
More than once a week-Less than once a day	45 (45.5)	44 (48.9)	43 (45.3)	53 (57.6)	185 (49.2)	0.225
Once a day	37 (37.4)	34 (37.8)	44 (46.3)	31 (33.7)	146 (38.8)	
More than once a day	17 (17.2)	12 (13.3)	8 (8.4)	8 (8.7)	45 (12.0)	
Fluoridated Toothpaste Use						
Yes	48 (48.5)	45 (50.0)	39 (41.1)	32 (34.8)	164 (43.6)	0.132
No	51 (51.5)	45 (50.0)	56 (59.0)	60 (65.2)	212 (56.4)	

**Results of the Pearson Chi-Square test. The statistical significance value was 0.05. Values with different superscript letters are statistically significantly different. CAST: Caries Assessment Spectrum and Treatment.*

education level ($p < 0.001$), no statistically significant difference was found between sexes. The number of individuals who consumed junk food never or less than once per week was significantly higher in the healthy/pre-morbidity group (33.3%) than that in the mortality group ($p < 0.001$). The number of children in the mortality group increased as the frequency of junk food consumption increased ($p < 0.001$). No significant relationship was observed between the frequency of tooth brushing ($p = 0.225$), the use of fluoride toothpastes ($p = 0.132$), and the stages of caries.

Supplementary Table 1 shows the mean values of each CEBQ subscale according to the sociodemographic and clinical characteristics. No significant differences were observed between groups in terms of sex. Significant differences were found across dental caries in the DD ($p = 0.002$), SE ($p = 0.001$), EUE ($p = 0.008$), and FF ($p = 0.001$) subscales among the children included in the study. Children in the mortality category had higher mean values than those in the other groups. When the frequency of junk food consumption was examined, a significant difference was observed in FR ($p = 0.041$), DD ($p < 0.001$), SR ($p = 0.003$), and EUE ($p = 0.016$). It was determined that as the junk food consumption frequency increased, CEBQ subscale values also increased. Children from families with higher socioeconomic status and parental education levels had a lower DD ($p = 0.002$ and $p = 0.004$, respectively). EUE values were higher in families with higher educational levels ($p = 0.020$).

The mean values of parental feeding styles according to sociodemographic and clinical characteristics are shown in Table 2. No significant differences were found between sexes. When the stages of dental caries morbidity were compared, a statistically significant difference was observed between instrumental ($p = 0.005$) and emotional feeding ($p = 0.003$). The highest values were observed in the mortality group. A significant difference was found in all PFSQ factors (C, $p = 0.013$; I, $p = 0.021$; EN, $p = 0.003$; EM, $p < 0.001$) according to the frequency of junk food consumption. Higher values were observed in the children who consumed junk food more frequently. A significant difference was found in instrumental ($p = 0.011$) and emotional feeding ($p = 0.001$) according to the socioeconomic level. Higher values were observed in children with low socioeconomic levels. No significant relationship was found between the parental educational level and PFSQ score.

When the associations between CEBQ and PFSQ subscales and the maximum CAST score were examined using multiple linear regression analysis adjusted for junk food consumption, parental education level, and socioeconomic status, the overall model was statistically significant (Table 3; $F = 7.437$, $p < 0.001$), explaining 27.3% of the variance in maximum CAST scores (adjusted $R^2 = 0.236$). Among the CEBQ subscales, higher Slowness in Eating ($p = 0.016$) and Food Fussiness ($p = 0.002$) scores were independently associated with higher maximum CAST scores. Among the PFSQ subscales, Emotional Feeding remained significantly associated with caries severity after adjustment ($p = 0.037$). Regarding covariates, more frequent junk food consumption (>4 days/week), lower parental education levels, and lower socioeconomic status were independently associated with higher maximum CAST scores. Multicollinearity was assessed using variance inflation factors (VIF), and all VIF values were below 2, indicating no evidence of problematic multicollinearity.

4. Discussion

This study aimed to evaluate the association between dental caries severity and children's eating behaviors and parental feeding styles in preschool children. Our findings contribute nuance to the existing literature by demonstrating that these behavioral factors are not only associated with the presence of dental caries but also with its severity across various caries stages. The use of the CAST index enabled the assessment of caries progression from pre-morbidity to mortality, providing clinically relevant insights into behavioral factors associated with increased caries severity. In addition, this study contributes region-specific data from Turkey, where early childhood caries remains highly prevalent, addressing a gap in evidence from developing countries. The combined use of validated behavioral instruments (CEBQ and PFSQ) together with regression-based analysis further strengthened the identification of specific subscales independently associated with increased caries severity.

Various indices for the evaluation of dental caries are available in the literature. The difficulties experienced in the most used decayed, missing, and filled teeth (DMFT/dmft), International Caries Detection and Assessment (ICDAS/ICDAS II), and pulp involvement, ulceration, fistula, and abscess (PUFA/pufa) indices. These have necessitated the need for a new index. In 2011, Frencken *et al.* [12] defined a new index called the Caries Assessment Spectrum and Treatment (CAST) based on the need for a single index that includes both early and advanced stages of caries. The index indicates the severity of caries with increasing scores, from healthy tooth surfaces to teeth with fissure sealants and restorations, carious lesions with enamel, dentin, and pulp involvement, teeth with abscesses or fistulas, and teeth lost due to dental caries [13]. The index has been confirmed to be reproducible for use in both primary and permanent dentition [18]. A person's maximum CAST score (the worst condition seen in the mouth) allows examination at five different stages (healthy, pre-morbidity, morbidity, severe morbidity, and mortality) according to the severity of the condition [13]. In this study, the caries status was evaluated using the CAST index.

Different questionnaires were used to evaluate children's feeding behaviors. The Children's Eating Behavior Questionnaire (CEBQ), developed by Wardle *et al.* [9], was used to evaluate children's eating behaviors. It is a validated tool developed to evaluate the eating behavior of children aged 2–9 years and their relationship with body mass index (BMI). The reliability and validity of the Turkish questionnaire have been confirmed [16]. The CEBQ is considered one of the most comprehensive and effective tools for evaluating children's eating behaviors. This questionnaire has also been used in different studies to evaluate the relationship between early childhood caries and children's eating behaviors [5, 6, 11]. In this study, the parents' feeding styles were assessed using the PFSQ, which was developed by Wardle *et al.* [10] (2002) and is a reliable tool for assessing obesity and parental feeding styles

TABLE 2. Comparison of PFSQ factor values in terms of sex, CAST categories, junk food consumption, socioeconomic status, and education level.

Category/Variables	n (%)	Control over eating Mean ± SD Median (25%/75%)	Instrumental feeding Mean ± SD Median (25%/75%)	Encouragement to eat Mean ± SD Median (25%/75%)	Emotional feeding Mean ± SD Median (25%/75%)
Gender					
Female	210 (55.8)	3 ± 0.46 3 (2.7/3.3)	2.29 ± 0.81 2.25 (1.75/3.0)	3.6 ± 0.62 3.69 (3.25/4.0)	2.49 ± 0.9 2.4 (1.8/3.2)
Male	166 (44.2)	3.01 ± 0.48 3 (2.7/3.3)	2.28 ± 0.91 2.25 (1.5/3.0)	3.64 ± 0.68 3.69 (3.25/4.13)	2.58 ± 1.01 2.4 (1.8/3.2)
p-value**		0.866	0.592	0.442	0.508
CAST Categories					
Healthy/Pre-morbidity	99 (26.4)	2.96 ± 0.52 3 (2.6/3.3)	2.11 ± 0.79^{a} 2 (1.5/2.75)	3.54 ± 0.68 3.63 (3.0/4.0)	2.28 ± 0.78^{a} 2.2 (1.8/2.6)
Morbidity	90 (23.9)	3.03 ± 0.49 3.1 (2.78/3.40)	2.20 ± 0.87^{a} 2 (1.5/2.81)	3.67 ± 0.67 3.75 (3.38/4.0)	2.42 ± 0.86^{a,b} 2.4 (1.8/3.0)
Severe Morbidity	95 (25.3)	2.97 ± 0.5 2.9 (2.7/3.2)	2.31 ± 0.85^{a} 2.25 (1.75/2.75)	3.64 ± 0.60 3.63 (3.25/4.0)	2.61 ± 0.96^{b,c} 2.6 (2.0/3.2)
Mortality	92 (24.4)	3.06 ± 0.33 3.1 (2.83/3.3)	2.53 ± 0.86^{b} 2.5 (1.81/3.0)	3.64 ± 0.64 3.75 (3.25/4.13)	2.83 ± 1.10^{c} 2.7 (1.8/3.8)
p-value*		0.141	0.005	0.283	0.003
Junk Food Consumption					
None or 1 day a week	65 (17.3)	2.89 ± 0.48^{a} 2.8 (2.6/3.2)	2.03 ± 0.76^{a} 2 (1.38/2.75)	3.35 ± 0.79^{a} 3.38 (2.81/4.0)	2.07 ± 0.83^{a} 2 (1.4/2.6)
2–3 days a week	123 (32.7)	2.99 ± 0.50^{a,b} 3 (2.7/3.3)	2.26 ± 0.83^{a,b} 2.25 (1.75/2.75)	3.68 ± 0.67^{b} 3.75 (3.13/4.25)	2.54 ± 0.87^{b} 2.4 (2.0/3.2)
More than four days a week	188 (50.0)	3.04 ± 0.44^{b} 3.1 (2.8/3.4)	2.39 ± 0.88^{b} 2.5 (1.75/3.0)	3.67 ± 0.56^{b} 3.75 (3.38/4.0)	2.68 ± 0.99^{b} 2.6 (2.0/3.4)
p-value*		0.013	0.021	0.003	<0.001
Socioeconomic Status					
Low	146 (38.8)	2.97 ± 0.51 3 (2.7/3.3)	2.40 ± 0.83^{a} 2.5 (1.75/3.0)	3.56 ± 0.64 3.63 (3.09/4.0)	2.69 ± 0.97^{a} 2.6 (2.0/3.4)
Middle	173 (46.0)	3.03 ± 0.44 3.1 (2.8/3.3)	2.28 ± 0.88^{a} 2.25 (1.5/3.0)	3.68 ± 0.65 3.75 (3.38/4.13)	2.53 ± 0.96^{a} 2.4 (1.8/3.2)
High	57 (15.2)	2.99 ± 0.43 3 (2.65/3.4)	2.01 ± 0.78^{b} 2 (1.38/2.5)	3.59 ± 0.67 3.63 (3.25/4.0)	2.14 ± 0.77^{b} 2 (1.6/2.6)
p-value*		0.348	0.011	0.108	0.001
Education Level					
Primary school	91 (24.2)	2.97 ± 0.48 3 (2.7/3.3)	2.47 ± 0.9 2.5 (1.75/3.0)	3.5 ± 0.7 3.63 (3.0/4.0)	2.71 ± 0.97 2.6 (2.0/3.4)
Highschool	107 (28.5)	2.98 ± 0.51 3 (2.6/3.3)	2.25 ± 0.82 2.25 (1.5/3.0)	3.65 ± 0.67 3.75 (3.25/4.13)	2.44 ± 0.96 2.4 (1.6/3.2)
University	178 (47.3)	3.03 ± 0.43 3.1 (2.78/3.4)	2.21 ± 0.84 2.25 (1.5/2.81)	3.66 ± 0.6 3.75 (3.38/4.0)	2.49 ± 0.93 2.4 (1.8/3.0)
p-value*		0.397	0.083	0.105	0.179

**Results of the Kruskal-Wallis test. **Results of Mann-Whitney U test (Mann-Whitney U test was used for pairwise comparisons). The statistical significance value was 0.05. Values with different superscript letters are statistically significantly different. CAST: Caries Assessment Spectrum and Treatment; SD: standard deviation.*

TABLE 3. Association between the CEBQ and PFSQ subscales and the maximum CAST score using multiple linear regression analysis, considering junk food consumption, education level, and socioeconomic status.

	Unstandardized Coefficients		Standardized Coefficients	*p* values	95% Confidence Interval for Beta	
	Beta	SE	Beta		Lower Bound	Upper Bound
Food responsiveness	0.015	0.278	0.004	0.957	−0.146	0.154
Enjoyment of food	0.028	0.191	0.008	0.884	−0.102	0.119
Emotional overeating	0.159	0.253	0.044	0.529	−0.093	0.180
Desire to drink	−0.076	0.142	−0.028	0.595	−0.130	0.075
Satiety responsiveness	0.088	0.251	0.020	0.727	−0.092	0.132
Slowness in eating	0.594	0.246	0.129	0.016	0.024	0.235
Emotional undereating	−0.158	0.189	−0.044	0.405	−0.149	0.060
Food fussiness	0.971	0.316	0.168	0.002	0.061	0.275
PFSQ Subscales						
Control over eating	−0.197	0.333	−0.031	0.554	−0.135	0.073
Instrumental feeding	−0.170	0.234	−0.049	0.469	−0.182	0.084
Encouragement to eat	0.098	0.246	0.022	0.690	−0.085	0.128
Emotional feeding	0.405	0.218	0.130	0.037	−0.008	0.268
Junk Food Consumption (Reference level: None or 1 day a week)						
2–3 days a week	0.765	0.418	0.259	0.068	−0.019	0.537
More than four days a week	1.035	0.403	0.350	0.011	0.082	0.617
Education Level (Reference level: University)						
Primary school	1.586	0.406	0.536	<0.001	0.266	0.806
Highschool	1.355	0.358	0.458	<0.001	0.220	0.696
Socioeconomic Status (Reference Level: High)						
Low	1.756	0.502	0.593	<0.001	0.260	0.927
Middle	1.564	0.433	0.529	<0.001	0.241	0.816

SE: Standard Error; PFSQ: Parental Feeding Style Questionnaire. $F = 7.437$, $p < 0.001$, $R^2 = 0.273$, Adjusted $R^2 = 0.236$. The Enter method was used to include independent variables into the model. Multicollinearity was assessed using variance inflation factors (VIF), and all VIF values were below 2.

in children. Moreover, its reliability and validity in the Turkish population have been confirmed [17], and it has been used in several studies to examine the relationship between parental feeding styles and early childhood caries [11, 19]. Although the Turkish validity and reliability studies of the CEBQ and PFSQ were conducted in 2010 and 2011, these instruments continue to be widely used in contemporary research, and no updated Turkish validation studies have been published to date [20, 21].

Socioeconomic status and education level are associated with the presence of caries. Consistent with previous studies, the number of children with advanced stages of caries (severe morbidity and mortality) was higher in families with lower socioeconomic status and educational levels [4, 22]. In our study, no significant differences were found between tooth brushing frequency, fluoride paste use, and tooth decay. The brushing effectiveness in preschool children (<6 years old) was weaker than in school-aged children due to their underdeveloped motor skills [23]. In addition, young children tend to brush their teeth for shorter periods than required for proper plaque removal [24]. Many parents reported that it usually takes less than a minute for their children to brush their teeth on their own [25]. Tooth brushing is a mechanical cleaning to remove plaque from teeth. The most effective way to prevent the formation of tooth decay is to effectively remove dental plaque (or biofilm) from the tooth surface. When mechanical cleaning cannot be done effectively, the use of fluoride toothpaste has been reported to be ineffective in preventing tooth decay [26, 27]. The fluoride

content of toothpaste used for children in our country is 500 ppm; however, toothpastes containing more than 1000 ppm fluoride have a significant effect on preventing tooth decay [28]. The American Academy of Pediatric Dentistry (AAPD) also recommends using a pea-sized amount of toothpaste for children under six [29]; however, in practice, many parents use less toothpaste than is needed [25]. All these factors are thought to be effective in the absence of a significant relationship between brushing frequency, fluoride paste use, and caries development in our study.

In this study, significant differences were found in the CEBQ's DD, SE, EUE, and FF subscales and PFSQ's instrumental and emotional feeding factors in terms of caries status. Beyond the statistical associations observed, these findings carry important implications for everyday pediatric dental practice.

The findings of this study have clear clinical relevance for pediatric dental practice by demonstrating that children's eating behaviors and parental feeding styles are associated with increasing caries severity. While current preventive approaches primarily focus on oral hygiene and fluoride use, our results indicate that these strategies may be insufficient if behavioral risk factors are overlooked. Higher scores in desire to drink, slowness in eating, food fussiness, and emotional feeding were linked to more advanced CAST stages, suggesting that such behaviors may help identify children at risk of disease progression. The stage-based CAST assessment further supports clinical decision-making by enabling more targeted preventive counseling and follow-up, particularly in high-risk preschool children. Accordingly, the following sections discuss the potential mechanisms underlying the observed associations between specific eating behavior traits, parental feeding styles, and caries severity.

The desire to drink (DD) subscale assesses the consumption of any type of beverage by the children. The increase in the consumption of beverages with high sugar and acid content but low nutritional benefits (*e.g.*, soft drinks) is a concern for both general and oral health [30], and studies have shown that the consumption of sugary beverages is associated with the incidence of caries [31, 32]. In the present study, the DD scores were significantly higher in children with advanced stages of caries (severe morbidity and mortality), consistent with previous studies [5, 11, 33]. Additionally, a significant increase in DD was observed as the frequency of junk food consumption increased. In a study conducted by Sweetman *et al.* [34], the DD in children was not only related to thirst or hunger, but also by the preference for sugary drinks. Kamin *et al.* [35] have shown in their studies that communication tools (*e.g.*, posters, booklets, stickers, web page, prize competitions, brochures, lessons, face-to-face discussions, *etc.*) with children, families and school personnel and environmental changes such as removing sugary drinks from school menus and replacing them with water, unsweetened tea or mineral water reduce the consumption of sugary drinks and increase water consumption. The implementation of such studies in our country may have positive effects on both systemic and oral health by reducing the consumption of sugary drinks.

Slowness in eating refers to a decrease in the speed of eating due to a lack of interest and enjoyment in eating. Children may develop "cognitive aversion" and exhibit food avoidance characteristics (fussiness and SE) when they perceive that they are forced to eat certain types of food (*e.g.*, vegetables) and quantities. Furthermore, maternal pressure to eat has been associated with slow eating habits [36]. Unlike some studies in the literature [5, 11], this study found that SE was significantly less common in the healthy/pre-morbidity stages of caries, consistent with Charak *et al.* [33]. It is thought that SE causes food to remain in the mouth for a longer period of time, which in turn leads to longer contact between the tooth surfaces and the food, leading to a higher prevalence of caries.

Emotional undereating refers to decreased eating behavior in children in negative emotional states such as sadness and anger. In this study, a significant difference was found between EUE and the stage of caries mortality. Several studies reported a significant increase in the prevalence of caries with increased EUE [11, 37]. Meijing *et al.* [38] observed positive correlation between children's EUE score and frequency of consumption of ultra-processed foods (UPFs), such as sugar-sweetened beverages and packaged snacks. Children may eat less and consume certain UPFs to satisfy their satiety requirements when experiencing negative emotions [38]. Another study reported that the consumption of potatoes, chips, and cookies decreased in children with EUE, but chocolate consumption, which was the most important contributor to their caloric intake, continued [39]. In this study, caries severity increased with increasing EUE score, likely because children continued to consume certain foods that may be cariogenic when experiencing negative emotions. Additionally, children from families with higher educational levels had higher EUE values, consistent with Umoko *et al.* [40], who reported more frequent EUE tendencies among participants with higher education levels.

Food fussiness refers to the rejection of a large portion of both familiar and novel foods, resulting in inadequate food variety. Preschool children with food selectivity consume fewer fruits and vegetables [41]. Tharner *et al.* [42] reported that picky eaters consume more snacks such as cookies, potato chips, and fast food, and that mothers are more tolerant in allowing their children to eat tasty but unhealthy foods to compensate for the lower intake of other foods. In the present study, FF scores were significantly higher in the mortality group than those in the control group. Several studies have shown that FF is associated with an increased incidence of caries [6, 11, 43]. These studies suggest that FF may increase caries development, resulting in the application of a cariogenic diet.

When the relationship between the socioeconomic status, educational level, and CEBQ score was examined, a significant difference was found in the section on DD. Similar to the results of different studies, in this study, DD scores decrease in children of families with a high socioeconomic status [5, 43]. In the literature, it has been shown that consumption of sugary beverages is more common in children of families with low socioeconomic status and educational levels [44].

Control overeating refers to the parents controlling the food consumed by their children. The control feeding style is associated with more frequent consumption of fruits/vegetables and less frequent consumption of high-energy foods and sugary

drinks [45, 46]. Parental control over eating has been associated with a lower risk of new carious lesions in children [19]. However, in this study, although no statistically significant difference was observed in terms of caries development stages in the control overeating, the current caries status became more severe as parental control increased. This situation can be attributed to the idea that with increasing parental control, the child is imposed with a diet that he/she does not like, and as a result, the child develops food selectivity that can lead to the development of caries, as stated in a study by Nembhwani *et al.* [11] with similar results. Indeed, the increase in the frequency of junk food consumption observed in this study with the control group supports this idea. In addition, it can be thought that forcing the child to follow certain eating rules with controlled feeding behavior may contribute to the development of caries by causing the child to eat slowly or to keep food in the mouth.

Instrumental feeding refers to rewarding children with food. In the current study, instrumental feeding was significantly more common in the mortality group. A study by Jie Wen *et al.* [19] reported that children of parents who increased their "instrumental feeding" tendencies had a higher risk of new caries lesions. Previous studies have shown that instrumental feeding is positively associated with the intake of foods with high sugar content [38, 45, 46]. In line with the literature, this study found that as instrumental feeding increased, the frequency of junk food consumption increased significantly.

Encouragement to eat involves motivating children to eat, try, and taste new foods. In this study, similar to the results of previous studies, no significant relationship was found between EN and caries status [11, 19]. Encouraging eating can reduce the consumption of snacks and sugar-sweetened beverages with a high energy content [45, 46]. It has been stated that encouraging children's interest and curiosity in tasting and eating various foods is beneficial for reducing their consumption of sugar-sweetened and energy-dense food products [47]. Surprisingly, we observed that as EN increased, the frequency of junk food consumption also increased. It is thought that this result may be due to parents allowing the child to eat a snack containing sugar (*e.g.*, chocolate) that they like, provided that they taste new foods.

Emotional feeding refers to the provision of food to children by parents to meet their emotional needs. In line with Newbhani *et al.* [11], our study found that as EM increased, caries severity increased significantly. Similar to instrumental feeding, EM is reported to be positively associated with the intake of sugar-sweetened and high-energy-density foods [38, 46]. In the present study, junk food consumption significantly increased with an increase in EM.

When the relationship between socioeconomic status and PFSQ was examined, a significant relationship was found between instrumental and emotional feeding styles and socioeconomic status. Instrumental and emotional feeding increased in families with low and medium socioeconomic status. Instrumental and/or emotional feeding is associated with inadequate fruit and vegetable consumption and is positively associated with high-energy-density food intake [45, 46]. The high sugar content diet in children from low socioeconomic status may be attributed to the relatively lower cost of these foods. High socioeconomic status is associated with increased purchase and consumption of healthy foods [48]. Although there was no significant relationship between educational level and PFSQ scores, it was observed that as educational level increased, control and encouragement to eat increased, while instrumental and emotional feeding decreased.

After adjustment for junk food consumption, parental education level, and socioeconomic status, Slowness in Eating, Food Fussiness, and Emotional Feeding remained independently associated with higher caries severity. These findings suggest that modifiable eating behaviors and parental feeding practices may contribute to caries severity beyond sociodemographic determinants in preschool children.

This study has several limitations. First, the long-term effects of eating behavior on the development of dental caries were not assessed. Second, children's dietary intake behaviors were reported by parents. Children's exposure to different food environments at school or home with a caregiver may cause parents to underestimate their children's snacking and consumption of soft drinks. In addition, parents may provide socially desirable responses to items related to their children's eating behaviors. Third, owing to the cross-sectional design of our study, the data obtained cannot be representative of the entire country. Despite these limitations, this study had several strengths. Children's eating behaviors were assessed using two different questionnaires with confirmed internal consistency and reliability: the CEBQ and PFSQ. The CEBQ is considered the most detailed tool used to assess eating behavior. The effect of eating behavior on the severity of current caries was observed using the CAST index.

5. Conclusions

In conclusion, the obtained data showed that unhealthy eating behaviors in children cause an increase in the current caries status. The study showed that the CEBQ drinking passion, slow eating, emotional undereating, and food selectivity subscales increased the status and severity of dental caries. In addition, instrumental and emotional feeding styles were associated with increased caries severity, particularly among children from lower socioeconomic backgrounds. These findings suggest that feeding behaviors contribute to the multifactorial etiology of dental caries and highlight the importance of considering behavioral factors alongside traditional preventive strategies. Identifying behavioral risk markers early in life represents an underexplored area in pediatric dentistry. Future studies integrating behavioral screening with preventive interventions may enhance individualized caries management and improve long-term oral health outcomes in preschool children.

ABBREVIATIONS

CAST, Caries Assessment Spectrum and Treatment; CEBQ, Child Eating Behavior Questionnaire; PFSQ, Parental Feeding Style Questionnaire; FAS, The Family Affluence Scale; FR, Food Responsiveness; EF, Enjoyment of Food; EO, Emotional Overeating; DD, Desire to Drink; SR, Satiety Responsiveness; SE, Slowness in Eating; EUE, Emotional Undereating; FF, Food Fussiness; C, Control over eating; I, Instrumental

feeding; EN, Encouragement to eat; EM, Emotional feeding; SD, standard deviation; IQR, interquartile range; VIF, variance inflation factors; DMFT/dmft, decayed, missing, and filled teeth; ICDAS, International Caries Detection and Assessment; PUFA/pufa, pulp involvement, ulceration, fistula, and abscess; BMI, body mass index; AAPD, American Academy of Pediatric Dentistry; UPF, ultra-processed foods.

AVAILABILITY OF DATA AND MATERIALS

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

AUTHOR CONTRIBUTIONS

GÖ and HG—conceived the idea; contributed to revising the manuscript critically. ET and MK—were involved in the study data collection. GÖ—contributed to statistical analyses. All authors were involved in study interpretation and writing and reviewing the manuscript, including final approval.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the Clinical Research Ethics Committee of Erciyes University (Approval date: 04 January 2023, Approval no: 2023/16). The procedures used in this study adhere to the tenets of the Declaration of Helsinki. Informed consent was obtained from all participants' parents.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

SUPPLEMENTARY MATERIAL

Supplementary material associated with this article can be found, in the online version, at https://oss.jocpd.com/files/article/2049735409653432320/attachment/Supplementary%20material.docx.

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