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Original Article

Dentistry Section

Assessing the Relationship between Healthy Eating and Oral Health Status among School Children Aged 7-12 Years in Chengalpattu, Tamil Nadu, India: A Cross-sectional Study

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ABSTRACT

Introduction: Diet plays a major role in children's nutritional status. Dietary intake and snacking habits, including consumption of low-nutrient-dense foods and high-sugar foods, contribute to the development of dental caries. The World Health Organisation (WHO) has reported that the prevalence of dental caries is higher among school children.

Aim: To assess the Healthy Eating Index (HEI) and snacking patterns and their association with oral health status among children aged 7 to 12 years.

Materials and Methods: An analytical cross-sectional study was conducted among 800 school children at the Karpaga Vinayaga Institute of Dental Sciences, Chengalpattu district, Tamil Nadu, India, over a six-month period (August 2023-January 2024). A four-part questionnaire collected data on demographic variables, HEI, snacking patterns and caries assessment. Oral hygiene status was measured using the Decayed, Missing and Filled Teeth (DMFT) index and the Oral Hygiene Index-Simplified (OHI-S), respectively, according to standard guidelines. Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) version 20, with $p<0.05$ considered statistically significant.

Results: Among the 800 children, 460 (57.5%) were male and 340 (42.5%) were female, with a mean age of 9.14±1.54 years. The majority were in the fair HEI category 539 (67.4%) and had an unhealthy snacking pattern 659 (82.4%). The poor-HEI group had higher mean DMFT and OHI-S scores (1.85±2.13 and 1.61±0.51, respectively) compared with the good and fair HEI groups. There was a statistically significant difference in OHI-S scores among the HEI groups ($p<0.001$). Participants with unhealthy snacking patterns had higher DMFT and OHI-S scores (1.51±1.97 and 1.47±0.53, respectively); however, there was no significant difference compared with the healthy-snacking group ($p>0.05$). HEI showed a negative relationship with DMFT scores ($r=-0.34$, $p=0.333$) as well as with OHI-S ($r=-0.89$, $p<0.012$), indicating that lower HEI is associated with higher DMFT and poorer oral hygiene. Age and parental occupation were both significantly associated with DMFT scores in the linear regression model. HEI was found to be a significant predictor of OHI-S scores.

Conclusion: Children with poorer HEI scores had worse oral health and more dental caries. Children should be encouraged to eat healthily and to limit the intake of added sugars from sweetened beverages and meals to reduce the risk of dental illnesses.

Keywords: Dental caries, Diet, Nutritional status, Oral hygiene, Snack food

INTRODUCTION

The World Health Organisation (WHO) considers good oral health essential for a good quality of life [1]. The consumption of sugar-sweetened beverages, junk foods, fermentable carbohydrates, nutrient-poor foods and a lack of nutrient-rich foods is particularly harmful for young children who are growing and developing rapidly, making them more susceptible to nutrition-related diseases such as malnutrition and tooth decay [2].

Dental caries is a multifactorial disease and diet is one of its contributing factors, as documented by numerous studies [1-3]. According to the WHO, dental caries affect 60% to 90% of school children [4]. Caries in deciduous teeth affect more than 530 million children worldwide. According to the National Oral Health Survey Report 2004, caries prevalence in India was 51.9%, 53.8% and 63.1% at ages 5, 12 and 15 years, respectively, in different parts of India [5].

Economic development, globalisation and urbanisation have led populations to switch from traditional minimally processed diets rich in staple vegetables to diets high in meat and ultra-processed snack foods. Snacking has gained an increasing role as a risk indicator for the development of caries in children [6]. Energy-dense, low-nutrient-dense foods are often characterised by a high content of added sugar, but several modern snack products such as chips (crisps), popcorn and shrimp crackers—although not sweet—are still potentially cariogenic due to their content of extensively hydrolysed starch [7]. Moreover, lifestyle choices such as watching more television and spending more time on social media while eating unhealthy foods may also contribute to the development of dental caries [8].

Various dietary quality indices for children have been developed across different countries. Golley RK et al., (2011) developed and validated the Dietary Guideline Index for Children and Adolescents; Marshall S et al., (2012) developed and validated the Australian Child and Adolescent Recommended Food Score; and Kennedy et al., developed the HEI [9-11]. Dietary indices are recommended for monitoring nutritional status in populations. Therefore, several indices are available to monitor dietary patterns, among which the HEI is used to assess the consumption of specific food groups such as healthy and unhealthy foods [12].

To date, no literature has revealed the relationship between snacking habits and healthy eating patterns for assessing the oral health of school children using the HEI. Therefore, the aim of the current study

was to assess the HEI and snacking patterns and their association with oral health status among children aged 7 to 12 years (mixed dentition period).

MATERIALS AND METHODS

An analytical cross-sectional study was conducted among 800 school children at the Karpaga Vinayaga Institute of Dental Sciences, Chengalpattu district, Tamil Nadu, India, to assess the HEI and snacking pattern and their association with the oral health status among 7-12-year-old school children in private and government schools in Chengalpattu district, Tamil Nadu, India, over a six-month period (August 2023-January 2024). The planning of the study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [13]. Ethical clearance was obtained from the Institutional Ethical Committee before starting the study (KIDS/IEC/2023/II/004). Informed consent from the parents, assent from the children and permission from the school authorities were obtained before data collection.

Inclusion and Exclusion criteria: Participants aged 7-12 years who were attending the selected schools were included in the study. Children younger than 7 years or older than 12 years, as well as those with intellectual or physical disabilities, were excluded from the study.

Sample size calculation: The sample size estimation was calculated using G*Power software version 3.1, with an effect size of 0.11, a 5% allowable error, a 95% confidence interval and a power of 80%. The estimated sample size was 641, which was rounded off to 800. Initially, the required number of schools for the study was chosen using a two-stage cluster sampling method.

Study Procedure

All localities in Chengalpattu were listed in the first stage and two different locations were randomly selected from this list. Next, a list of all government and private secondary schools in the chosen areas was compiled. Using the lottery method, two government and two private secondary schools from each area were selected at random. Convenience sampling was used to choose the students.

The participants were given a brief overview of the study by a qualified examiner before data collection. The study used a four-part questionnaire to gather data. Section I collected the participants' demographic information. Section II assessed the Healthy Eating Index (HEI-2010) for school children, originally developed by Kennedy ET et al., (1995) [11]. Section III assessed snacking patterns and Section IV assessed the dental caries and oral hygiene status among school children.

Demographic information (Section I): Participants' demographic information, such as age, gender, frequency of tooth brushing and parental occupation, were recorded.

Measuring Healthy Eating Index (HEI) (Section II): The updated version of HEI-2010 [14] used in the present study consists of 12 components, among which 9 food groups and their scores are included (total fruit—5, including 100% natural fruit juices; whole fruit—5, excluding juices and extracts; total vegetables—5; greens and beans—5; whole grains—10; dairy—10; total protein foods—10; seafood and plant proteins—10; fatty acids—10) and 3 components consumed in moderation, which were given in reverse scoring (refined grains—10; sodium—10; and empty calories—10). The individual scores sum to a global score, expressed as a percentage (overall diet quantity is 100). A HEI score above 80% is considered adequate (good), 51-80% needs improvement (fair) and below 51% indicates poor diet quality [4,15].

Measuring snacking pattern (Section III): The snacking behaviour was assessed using a prestructured, self-administered six-item questionnaire and was evaluated for validity and reliability. Content validity was established by five experts: two public health dentists, two pedodontists and one parent. The CVI score of 0.93 indicated that the items were relevant. For reliability, Cronbach's alpha was 0.92, which is excellent. The questionnaire comprised the following items: type of snacks, frequency of snacks, number of snacks per day, timing of snacks, activities during snacking and rinsing after snacking. The overall sum score ranged from 0 to 10 and, for better representation of data, it was dichotomised into unhealthy eating (<5) and healthy eating (>5).

Section IV

i) Dental caries assessment: The assessment of dental caries was based on the Decayed, Missing and Filled Teeth (DMFT) index by Klein H et al., (1938) [16]. The decayed, missing and filled teeth were recorded. The DMFT index is a full-mouth index that includes all teeth except the third molar and is a universally accepted index. The instruments used to measure the DMFT index were a mouth mirror and an explorer. The def index (decayed, extracted and filled teeth), described by Gruebbel AO in 1944 [17], was an equivalent index to the DMF index and is used to measure dental caries in primary dentition. The sum of the decay component in the DMFT/def index has been considered for the evaluation of dental caries and the mean value was used for analysis.

ii) Oral hygiene assessment: The oral hygiene status was assessed by the Simplified Oral Hygiene Index (OHI-S) by Greene JC and Vermillion JR (1964) [18]. The instruments used to measure the OHI-S were a mouth mirror and a No. 23 explorer (Shepherd's hook). The OHI-S has two components, the Simplified Debris Index and the Simplified Calculus Index and assessments were made on six tooth surfaces. The debris and calculus scores are obtained by calculating the average of the individual scores, with interpretations as follows: Excellent (0), Good (0.1-1.2), Fair (1.3-3) and Poor (3.1-4). The OHI-S score was recorded and presented as mean and standard deviation.

STATISTICAL ANALYSIS

The recorded data were compiled and entered into Microsoft Excel and then exported to the data editor page of SPSS version 20.0. Quantitative variables were described by means and Standard Deviations (SDs). Qualitative variables were described by frequency and percent. The mean distribution of DMFT and OHI-S scores according to HEI category and snacking pattern was analysed using the Kruskal-Wallis test. Pearson's correlation and Spearman's correlation were used to assess the relationships between independent variables and outcome variables (DMFT and OHI-S) among the study participants. Predictors for DMFT and OHI-S were assessed using linear regression models.

RESULTS

In the present study, 800 school children were included, comprising 460 (57.5%) males and 340 (42.5%) females. The mean age was 9.14±1.54 years. Compared with professionals, a higher percentage of parents were in clerical, shop-owner, or farmer occupations (43.4%) [Table/Fig-1] [14,16-18].

Section I: Demographic variables		n (%)
1.	**Age (years) (Mean±SD)**	9.14±1.54
2.	**Gender**	
	Male	460 (57.5%)
	Female	340 (42.5%)
3.	**Parent occupation**	
	Professional	332 (41.5%)
	Semi professional	68 (8.5%)
	Clerical, shop owner, farmer	347 (43.4%)
	Skilled worker	39 (4.9%)

	Semiskilled worker	12 (1.5%)
	Unskilled worker	2 (0.3%)
4.	**Frequency of tooth brushing**	
	Once	597 (74.6%)
	Twice	203 (25.4%)
Distribution of DMFT, OHI-S, HEI, Snacking pattern among the study participants		
Section II: HEI [14]		**n (%)**
Good >80%		28 (3.5%)
Fair 51-80%		539 (67.4%)
Poor <51%		233 (29.1%)
Section III: Snacking Pattern (SP)		**n (%)**
Healthy food (Less than 5)		141 (17.6%)
Unhealthy food (More than 5)		659 (82.4%)
Section IV		**Mean±SD**
i. DMFT/def [16,17]		1.52±2.05
ii. OHI-S [18]		1.46±0.52

[Table/Fig-1]: A four-part questionnaire used in the study [14,16-18] (N=800).

The distribution of the participants' DMFT scores, OHI-S scores, HEI scores and snacking-pattern behaviour is shown in [Table/Fig-2]. The mean±SD DMFT index was 1.52±2.05 and the mean±SD OHI-S was 1.46±0.52. The majority of participants (67.4%) fell within the fair HEI category.

Variables	DMFT Mean±SD	p-value	OHI-S Mean±SD	p-value
HEI				
Good	1.04±1.83	0.08	1.25±0.44	<0.001**
Fair	1.40±2.00		1.41±0.52	
Poor	1.85±2.13		1.61±0.51	
Snacking pattern				
Less than 5 (Healthy)	1.50±2.34	0.159	1.41±0.50	0.059
More than 5 (Unhealthy)	1.51±1.97		1.47±0.53	

[Table/Fig-2]: Mean DMFT and OHI-S scores according to HEI category and snacking pattern.
Kruskal Wallis test for HEI*, t-test for Snacking pattern *; p<0.05 statistically significant

The mean distribution of DMFT and OHI-S among the HEI groups and snacking pattern is shown in [Table/Fig-2]. Compared with the good and fair HEI groups, the poor HEI group had a higher mean DMFT score (1.85±2.13) and there was no statistically significant difference between the HEI groups. Compared with the good and fair HEI groups, the poor HEI group had a higher mean OHI-S score (1.61±0.51); this difference was statistically significant (p<0.001). Regarding snacking pattern, unhealthy snacking pattern participants had higher DMFT (1.51±1.97) and higher OHI-S (1.47±0.53) scores, but the differences between snacking-pattern groups were not statistically significant.

The relationship between the independent variables and the outcome variables (DMFT and OHI-S) among the study subjects is shown in [Table/Fig-3]. Age showed a statistically significant negative correlation with DMFT (r=-0.175, p=0.001). Parental occupation showed a statistically significant correlation with DMFT (r=-0.085, p=0.016). The occupations of the parents were listed in order of rank; the DMFT score tended to decline with increasing parental occupational status. HEI and DMFT had a weak negative correlation (r=-0.34) with p=0.333 (not statistically significant). HEI and OHI-S showed a negative correlation (r=-0.89, p=0.012). A poorer HEI score correlated with higher DMFT and higher OHI-S indices.

Variables	DMFT r value	DMFT p-value	OHI-S r value	OHI-S p-value
Age	-0.175	0.001*	0.017	0.622
Parent occupation	0.085	0.016*	-0.001	0.977
HEI	-0.34	0.333	-0.89	0.012*
Snacking pattern	-0.011	0.759	0.034	0.342
Gender	0.050	0.154	0.006	0.858
Frequency of brushing	0.001	0.968	-0.065	-0.67

[Table/Fig-3]: Correlation between independent variables and outcome variables (DMFT and OHI-S) among the study participants.
Pearson correlation test for continuous variable (Age, Snacking pattern, Frequency of brushing) and Spearman correlation for categorical variable (Gender, HEI, Parent occupation); p<0.05, statistically significant*

Statistical analysis used include Pearson's correlation for continuous variables (age, snacking pattern, frequency of brushing) and Spearman's correlation for categorical/ordinal variables (gender, HEI category, parental occupation). A p-value <0.05 was considered statistically significant. Categorical variables were converted to ranked ordinal categories for analysis.

For the forward linear regression analysis [Table/Fig-4], age, HEI and parental occupation were included in the model. Age (p<0.001) and parental occupation (p=0.038) were significantly associated with DMFT scores and HEI was a significant predictor of overall oral health status (p=0.012) [Table/Fig-5]. Parental occupation was converted to a ranked ordinal category for analysis.

Variables	β	Std. error	p-value
DMFT			
(Constant)	2.31	0.542	0.0001*
HEI category	-0.002	0.002	0.364
Age	-0.238	0.046	0.0001*
Parent occupation	0.135	0.065	0.0380*

[Table/Fig-4]: Linear regression analysis for independent variable (HEI value, age, parent occupation) and dependent variable (DMFT).

Variables	β	Std. error	p-value
OHI-S			
(Constant)	1.042	0.083	0.0001*
HEI value	-0.001	0.001	0.012*

[Table/Fig-5]: Linear regression analysis for independent variable (HEI value) and dependent variable (OHI-S).
p<0.05, statistically significant*

DISCUSSION

The primary goal of the current study was to evaluate how school children's healthy eating and snacking behaviours affect their dental health.

Foods such as milk, cheese, unrefined plant foods, whole-grain foods and meat have been studied for their anticariogenic role. Of the many food components available, dietary sugars, fruit juices, concentrated sugary items and starchy foods have been implicated as having high cariogenic potential [19]. Recent years have seen an exponential rise in sugary food consumption and unhealthy snacking among school-aged children, with negative implications for their oral health and behavioural habits [20].

The majority of individuals in the current study (67.4%) belonged to the fair category of HEI (needing improvement) and 82.4% of the participants reported an unhealthy snacking pattern. A previous study by Inan-Eroglu E et al., stated that the majority of participants' dietary patterns fell into the needing improvement category (HEI scoring 51-80%) [21].

In the current study, the poor HEI group had a higher mean DMFT score (1.85±2.13). This is in accordance with the study by Inan-Eroglu E et al., which reported that the mean number of decayed teeth was significantly higher among children with poor diet quality (HEI) (4.2±4.3) compared with those with medium diet quality

(2.5±2.9) (p<0.05) [21]. According to previous research, children with better dietary consumption have a lower risk of developing caries than those with unhealthy dietary consumption [22]. Children should follow a healthy eating plan and a high-quality diet if they want to avoid developing dental caries. The current study found that children with good dietary practices were more likely to have good oral hygiene. The present findings corroborate Nakai Y and Mori-Suzuki Y research regarding the influence of food habits on plaque acidogenicity and oral hygiene status [23].

In the present study, school children with unhealthy snacking had higher mean DMFT scores. This is consistent with earlier studies by S et al., Iftikhar A et al., and Kaye EA et al., which found that the mean DMFT was higher among people who consumed soft drinks, cakes and sweets, reflecting unhealthy snacking behaviour. The frequent consumption of snacks among school children increases their risk of developing dental decay and is a primary risk factor for caries in young children [24-26]. It is clear from the current study that children who practiced unhealthy snacking had higher mean OHI-S scores, indicating poorer oral health. Poor snacking habits can increase the likelihood of developing cariogenic plaque and lead to poorer oral hygiene as a result of frequent consumption of cariogenic foods, which is consistent with a number of previous studies [20,27,28].

Age and tooth decay showed a significant inverse relationship (r=-0.175, p=0.001). This is in contrast to earlier research by Moca AE et al., who found higher caries levels in primary dentition compared with permanent dentition and to Popescu DM et al., who found that permanent dentition (60.5%) has a higher prevalence of caries than primary dentition (3.3%) [29,30].

Parental occupation and DMFT showed a weak positive correlation (r=0.085, p=0.016), which was statistically significant in the current study. The findings support the concept that lower family income and parental education are directly associated with a higher risk of dental caries among children [31]. This is consistent with the previous study by Gorgi Z et al., which stated that lower parental education leads to a higher risk of dental caries [32].

The HEI showed a weak negative correlation with DMFT (r=-0.34, p=0.333) and with OHI-S (r=-0.89, p=0.012), indicating that poorer HEI components increase DMFT and OHI-S scores. The findings support that poorer healthy eating (HEI) increases the risk of dental caries and poor oral health status (β=-0.11, 95% CI -0.54 to -0.30) [33]. This denotes that a poor HEI score is associated with increased tooth decay and poorer oral hygiene.

The study aligns with Priyadarshini P and Gurunathan D who showed that lower caries levels were correlated with higher intakes of total fruits, whole fruits, legumes, vegetables and added sugars in the HEI index (2010) (80.38±7.21 at 24 h; p=0.0001) [19].

Findings of the present study add to the growing body of evidence supporting a bidirectional association between high-sugar consumption, poor healthy eating behaviour and oral health. The study's strengths include its relatively large sample size and the use of a linear regression model.

Limitation(s)

It is important to acknowledge the limitations of the current study. First, as a cross-sectional study, causal relationships between variables could not be established. Convenience sampling used for sample recruitment may have introduced selection bias. Based on the subjects' eating patterns over the previous 24 hours, recall bias may occur in reporting food consumption.

CONCLUSION(S)

The present study concluded that children with poor HEI scores had worse oral hygiene and more tooth decay. There is consistent evidence that unhealthy snacking patterns negatively affect oral health (dental caries and overall oral health status). Age, parental occupation and HEI were significant predictors of tooth decay and oral hygiene status among school children. A vital public health strategy to lower the risk of oral diseases and improve overall health would be to promote healthy eating and restrict the consumption of added sugars from sweetened beverages and foods.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Oct 26, 2024
- Manual Googling: Jun 14, 2025
- iThenticate Software: Jun 21, 2025 (20%)

ETYMOLOGY: Author Origin

EMENDATIONS: 10

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- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

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