ORIGINAL RESEARCH

The Association between Dental Caries, Periodontal Status, and Sleep Patterns in Children

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Abstract

Aim and background: Sleep quality has a significant impact on children's overall health and is associated with oral diseases. This study aimed to investigate the relationship between dental caries, periodontal status, and sleep patterns in 8–12-year-old children.

Materials and methods: This cross-sectional study was conducted on 120 children aged 8–12 years. The children's sleep habits questionnaire (CSHQ) was employed to evaluate sleep status. Another questionnaire was used to collect data on lifestyle habits. Dental caries status was evaluated using the decayed, missing, and filled teeth (DMFT) and International Caries Detection and Assessment System (ICDAS) indices. Periodontal status was assessed through the plaque index (PI), probing depth (PD), gingival index (GI), and periodontal screening and recording (PSR). The association between oral health and sleep patterns was evaluated using Spearman's coefficient correlation, independent *t*-test, and the Chi-squared test.

Results: The ICDAS mean was significantly higher in children with improper sleep patterns ($p = 0.032$). However, there was no statistically significant relationship between DMFT and sleep patterns ($p = 0.346$). The GI, PD, and PSR mean were significantly higher in the inappropriate sleep pattern group. There was a significant relationship between children's sleep patterns and GI, PD, and PSR indices ($p = 0.033$, $p = 0.020$, $p = 0.028$, respectively). However, there was no significant association between PI and sleep patterns ($p = 0.277$).

Conclusion: Children's sleep patterns were associated with dental caries and periodontal status. Adequate sleep is required to prevent oral diseases such as dental caries and periodontal diseases.

Clinical significance: According to this study, it is recommended that children should be encouraged to get adequate sleep by their parents and dentists.

Keywords: Circadian rhythm, Dental decay, Lifestyle, Periodontal diseases, Sleep disorders.

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Introduction

According to the World Health Organization (WHO) Global Oral Health Status Report, oral morbidity is a major universal public health disease affecting >3.5 billion people worldwide.[1] Nowadays, oral and dental health is not only focused on maintaining the health of the teeth; it also plays a vital role in preserving the overall health of the body.[2,3]

Dental decay is one of the most usual oral diseases which affects all people groups.[4,5] The occurrence of dental caries is significantly increasing, and reports indicate that nearly 60–90% of schoolchildren and all adults experience this disease.[6] Preventing dental caries is a top priority for dental services and is widely recognized as a more cost-effective approach compared to treatment.[7,8]

The most prevalent chronic illness is periodontal disease, which affects the teeth's supporting tissues. The prevalence of periodontal disease has been shown to range between 20 and 50%. In fact, severe periodontal diseases were ranked as the 11th most common disease worldwide.[9–11]

Dental caries and periodontal disease are closely associated with individuals' lifestyles.[4,12,13] Sleep is considered a fundamental lifestyle behavior.[14] Moreover, it is essential to recognize that sleep patterns have a significant impact on the body's physiological functions, including hormonal secretions and oral functions.[15]

Healthy sleep is described by sufficient duration, high quality, proper timing, consistency, and the lack of sleep disorders.[16] Sleep disorders are significantly prevalent and disrupt the normal circadian rhythm, thereby creating negative effects on both psychological well-being and physical health.[17] Studies suggest that sleep disorders can cause changes in the metabolic, endocrine, immune, and inflammatory systems.[18] Several potential mechanisms contribute to the increased risk of oral diseases

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associated with sleep disturbances. These mechanisms include a reduced immune response, increased levels of inflammatory biomarkers [such as interleukin-6 (IL-6), tumor necrosis factor (TNF)-α, and C-reactive protein (CRP)], and increased susceptibility to infectious diseases.[19]

Considering the frequency of sleep disorders among children, their relationship with overall health is of interest to many researchers.[20,21] Nevertheless, there is a shortage of research on the impact of sleep patterns on the oral and dental health of children. Consequently, the aim of the present study was to evaluate the connection between sleep patterns and dental and periodontal health in children.

Materials and Methods

Design of the Study and Participants

This research was a descriptive-analytical and cross-sectional study carried out on 8–12-year-old children in Qom, Iran (2021–2022). Following the approval of the research ethics committee of Qom University of Medical Sciences, Qom, Iran, the samples were collected from seven elementary schools located in different areas of Qom city. A total of 120 children participated in the research (60 females, 60 males). After obtaining informed consent from the children's parents, the eligible children were included in the study. Inclusion criteria included mentally and physically healthy children aged 8–12 years. Exclusion criteria included suffering from chronic systemic disease, taking sedative or hypnotic drugs, having at least one parent with a mental illness, drug abuse by at least one parent, having a congenital oral disease, having a history of radiotherapy or chemotherapy, the child's noncooperation, missing dental screening data, and incomplete sleep pattern information. The distribution of participants was approximately equal, representing all social classes among the Qom population.

Information on Lifestyle

The study gathered information on lifestyle through a self-constructed questionnaire completed by a parent or guardian. The questionnaire consisted of various aspects such as demographic information of parents and children, infant feeding patterns, daily tooth brushing and flossing, use of fluoridated mouthwash, consumption of snacks, and intake of nutritional factors including dairy products, vegetables, and fruits.

Children's body mass index (BMI) were also recorded. The children were asked to wear lightweight clothing and remove their shoes and belts. Their weight was recorded using a digital scale (SBS 4414, Sinbo, China) with a precision of 100 gm. Additionally, their height was recorded using a wall meter with an accuracy of 0.5 cm. BMI was determined by dividing the weight value by the square of the height value.[22] A trained dentist then collected data after coordinating with school officials. BMI was classified to underweight (BMI < 18.5), normal (BMI 18.5–24.9), overweight (BMI 25–30), and obese (BMI > 30).[23]

Assessment of Children's Sleep Pattern

The sleep pattern was assessed using the Iranian context of the children's sleep habits questionnaire (CSHQ). The CSHQ, originally designed by Owens et al., is a widely used parent-report questionnaire that measures various dimensions of sleep habits. The reliability of the Persian version was evaluated using Cronbach's α, which resulted in a coefficient of 0.80 for the entire questionnaire. Convergent validity ranged from 0.4 to 0.86, while divergent validity ranged from 0.006 to 0.66. The questionnaire demonstrated good reliability in detecting sleep quality and habits among Iranian children.[24,25]

The CSHQ consists of 45 questions and eight subscales, including duration of sleep, bedtime resistance, sleep onset delay, sleep anxiety, night wakings, sleep-disordered breathing, parasomnias, and daytime sleepiness. The items on the questionnaire were scored using a three-point Likert scale—"usually" (score 3) was selected if the behavior occurred 5–7 times per week, "sometimes" (score 2) if it occurred 2–4 times per week, and "rarely" (score 1) if it occurred 0–1 time per week.

The total score, being the sum of all subscale scores, ranges from 33 to 99. In this scoring system, a score below 41 indicates an appropriate sleep pattern, while a score above 41 suggests an inappropriate sleep pattern. Higher scores indicate poorer sleep habits.[24]

Assessment of Dental Caries

The oral conditions of the children were evaluated by a trained dentist through visual inspection. The decayed, missing, and filled teeth (DMFT) and International Caries Detection and Assessment System (ICDAS) indices were used to diagnose dental caries. The clinical oral evaluations were conducted in selected schools, employing disposable dental mirrors, a WHO probe (Smart Instru, MS5201 model, Pakistan), and natural light. Prior to the procedure, the children underwent regular tooth brushing.

Decayed, Missing, and Filled Teeth

The DMFT index represents the total number of the decayed, missed, and filled tooth of the children.[13,26]

International Caries Detection and Assessment System

The ICDAS II is a scoring system used to assess the severity of caries. To apply the ICDAS system, it is necessary to examine clean and dry teeth. The following codes were used to record the severity—code 0 = sound; code 1 = first observable indication of noncavitated lesion observable only when the tooth is dry (restricted to within the confines of a pit or fissure); code 2 = observable noncavitated lesion apparent whenever wet and dry; code 3 = localized enamel breakdown without visual signs of dentine involvement; code 4 = underlying dark shadow from dentine either with or without localized enamel breakdown; code 5 = clear cavity with visible dentine; and code 6 = extensive cavitated lesion with visible dentine.[27,28]

Assessment of Periodontal Status

To evaluate periodontal health and record the periodontal indices, we employed several methods, including the gingival index (GI), plaque index (PI), probing depth (PD), and periodontal screening and recording (PSR). Clinicians can select specific teeth during mixed dentition instead of assessing the periodontal status of the full mouth. For instance, it has been suggested to perform a rudimentary assessment on index teeth 3, 8, 14, 19, 24, and 30.[29]

Gingival Index

The GI was created to assess both the severity and extent of gingival inflammation. Each of the four gingival areas (buccal, lingual, mesiobuccal, distobuccal) of the index teeth (3, 8, 14, 19, 24, and 30) was given a score from 0 to 3 as follows:

Score 0: Normal gingiva, the gingiva appears healthy, with no signs of inflammation. The color is pink, the tissue is firm, and without bleeding on probing.

Score 1: Mild inflammation, there may be slight changes in color, such as a slightly redder appearance compared to normal gingiva. The tissue may also exhibit mild edema. However, bleeding does not occur upon probing.

Score 2: Moderate inflammation, the gingiva appears noticeably red and exhibits increased edema. The tissue may have a shiny or glazed appearance. Bleeding may occur when the gingiva is probed.

Score 3: Severe inflammation, the gingiva appears significantly red and swollen, with pronounced edema. The tissue may bleed spontaneously or with minimal provocation, even without probing.

By averaging the scores, we provided a GI score for each patient.[29,30]

Probing Depth

In order to evaluate PD, the Michigan-O-Williams probe (Smart Instru, MS5201 model, Pakistan) was used to gauge the distance from the gingival margin to the base of the sulcus or pocket (the deepest point of probe penetration). The probe was inserted parallel to the longitudinal axis of the tooth, and the measurement was recorded at four specific sites of each tooth—mesiobuccal, buccal, distobuccal, and midlingual. Measurements were taken from the index teeth—3, 8, 14, 19, 24, and 30. The mean PD reflects periodontal tissue destruction.[29,31,32]

Plaque Index

Oral hygiene status was evaluated by examining the dental plaque on the index teeth (3, 8, 14, 19, 24, and 30), using PI criteria. We provided a PI score for each patient by averaging the PI scores. The PI was graded from 0 to 3 according to the Löe and Silness standard as follows:

0: No visible dental plaque.

1: A layer of plaque sticking to the free gingival margin and the surrounding area of the tooth. The presence of a thin layer of plaque in specific areas could be observed following the use of a probe on the tooth surface.

2: A moderate buildup of soft deposits in the gingival pocket or on the tooth and gingival margin, visible without the need for magnification.

3: A large quantity of soft debris present in the gingival pocket and/or on the tooth and gingival margin. This indicates a significant amount of plaque accumulation.[33,34]

Periodontal Screening and Recording

The PSR method was recommended to facilitate the early diagnosis of periodontal diseases in children. The PSR procedure involved dividing the dentition into six sextants—two anterior sextants (maxillary and mandibular) and four posterior sextants (left and right maxillary and mandibular). The gingival sulcus depth of each tooth was measured with a periodontal probe. Each sextant was assigned a code number from 0 to 4, representing the periodontal health status. Here is a breakdown of the code numbers:

Code 0: All sulcus depths in the sextant are 3.5 mm or less, with no calculus detected, and there is no bleeding upon probing.

Code 1: All sulcus depths are 3.5 mm or less, with no presence of calculus, but some bleeding on probing.

Code 2: All sulcus depths are 3.5 mm or less, with the presence of calculus. This code may also indicate the detection of calculus and/or defective margins.

Code 3: One or more sulcus depths are among 3.5 and 5.5 mm.

Code 4: One or more sulcus depths are >5.5 mm.[35]

Bias

The risk of bias was limited by excluding children with mental illness from the study. Reliable methods were employed to assess dental caries and periodontal conditions, thus further reducing the chance of bias. In addition to minimizing self-report bias, a standard questionnaire was utilized in this study to evaluate sleep patterns.

Statistical Analysis

Data analysis was performed using Statistical Package for the Social Sciences software and included descriptive statistics and percentages. Spearman's correlation, *t*-test, and the Chi-squared tests were used based on the types of variables. Correlation coefficient values ranging from 0.1 to 0.3 were considered "small," 0.3–0.5 were considered "medium," and 0.5–1.0 were considered "large."

Results

Participant's Demographic Information

In this study, the research sample consisted of 120 children. The gender distribution was balanced, with 60 females and 60 males included in the study. The age range of the participants was specifically limited to children between 8 and 12 years old. There was no significant gender difference (Chi-square, $p = 0.345$). There was no statistically significant difference based on age-groups (Chi-square, $p = 0.7$) (Tables 1 and 2).

Relationship among General Characteristics, Nutritional Factors, and Oral Health Behavior with Sleep Pattern

Sleep pattern was not statistically related to the number of mother's and father's education levels (Chi-square, $p = 0.058$, $p = 0.149$). The relationship between children's sleep patterns and the number of family members is not significant (Chi-square, $p = 0.737$). There is no significant relationship between children's sleep patterns and their BMI (Chi-square, $p = 0.280$) (Table 2).

There is no significant relationship between children's sleep patterns and diet-related variables (daily snack consumption, dairy products, fruit, and vegetable consumption) (independent *t*-test, $p = 0.741$, $p = 0.768$, $p = 0.951$, respectively) (Table 2).

Table 1: Frequency distribution of the participant's characteristics

Age	*Male (n)*	*Female (n)*	*Total (n)*
8 years	12	12	24
9 years	12	12	24
10 years	12	12	24
11 years	12	12	24
12 years	12	12	24
Total	60 (50%)	60 (50%)	120 (100%)

There is no significant relationship between children's sleep patterns and oral health behavior (daily dental flossing and mouthwash use per week, daily brushing duration and frequency) (independent *t*-test, $p = 0.644$, $p = 0.477$, $p = 0.477$, $p = 0.617$, respectively) (Table 2).

There is a significant relationship between children's sleep patterns and infant feeding patterns (Chi-square, $p = 0.011$) (Table 2).

Relationship among Nutritional Factors and Oral Health Behavior with Dental and Periodontal Health

Table 3 shows the relationship between oral health and the confounding variables recorded in this study.

There are no significant correlations between oral health behavior and dental caries, except for dental flossing use, which had a small negative correlation (correlation coefficient = −0.195, $p = 0.033$).

A significant small negative correlation was observed between daily brushing duration (minutes) and PI (correlation coefficient = −0.192, $p = 0.036$). There was also a significant positive correlation between mouthwash use per week and the PI (correlation coefficient = 0.183, $p = 0.045$).

A significant negative correlation was also detected between dental flossing use and mean GI (correlation coefficient = −0.224, $p = 0.014$).

Table 2: Association between general characteristics, nutritional factors, and oral health behavior with sleep pattern

Variables		*Healthy sleep pattern n (%)*	*Unhealthy sleep pattern n (%)*	*Mean ± SD (n = 120)*	*p-value*
Total	*N* = 120	22 (18.3)	98 (81.7)	–	–
General characteristics of the children					
Age-group	8–10 years	14 (63.6)	58 (59.2)	10 ± 1.42	0.700[&]
	>10 years	8 (36.4)	40 (40.8)		
Gender	Male	9 (40.9)	51 (52.0)	–	0.345[&]
	Female	13 (59.1)	47 (48.0)		
Biological and socioeconomic variables					
Mother's education	Not educated	0 (0.0)	3 (3.1)	–	0.058[&]
	Up to secondary school	1 (4.5)	17 (17.3)		
	Diploma	10 (45.5)	55 (56.1)		
	Bachelor's and above	11 (50.0)	23 (23.5)		
Father's education	Not educated	0 (0.0)	4 (4.1)	–	0.149[&]
	Up to secondary school	1 (4.5)	22 (22.4)		
	Diploma	13 (59.1)	40 (40.8)		
	Bachelor's and above	8 (36.4)	32 (32.7)		
Only child in the family	Yes	2 (9.1)	16 (16.3)	–	0.737[&]
	No	20 (90.9)	82 (83.7)		
BMI	Underweight	13 (59.1)	44 (44.9)	19.67 ± 4.53	0.280[&]
	Normal	8 (36.4)	38 (38.8)		
	Overweight	1 (4.5)	16 (16.3)		
Infant feeding pattern	Breast feeding	22 (100)	75 (76.5)	–	0.011*[&]
	Infant formula	0 (0.0)	23 (23.4)		
Maintaining oral hygiene					
Daily flossing use	Yes	4 (18.2)	14 (14.3)	–	0.644[&]
	No	18 (81.8)	84 (85.7)		
Mouthwash use per week	Yes	1 (4.5)	9 (9.2)	–	0.477[&]
	No	21 (95.5)	89 (90.8)		
Daily brushing frequency (times)		Healthy sleep pattern		1 ± 0.75	0.617^
		Unhealthy sleep pattern		1.04 ± 0.51	
Daily brushing time (minutes)		Healthy sleep pattern		2.45 ± 1.82	0.477^
		Unhealthy sleep pattern		2.28 ± 1.99	
Diet-related variables					
Daily snack consumption (times)		Healthy sleep pattern		1.52 ± 1.00	0.741^
		Unhealthy sleep pattern		1.56 ± 1.46	
Daily fruit and vegetable consumption (times)		Healthy sleep pattern		1.78 ± 0.81	0.951^
		Unhealthy sleep pattern		1.85 ± 1.11	
Daily dairy products consumption (times)		Healthy sleep pattern		1.46 ± 0.60	0.768^
		Unhealthy sleep pattern		1.58 ± 0.93	

*Statistically significant; [&]Chi-squared test; ^independent *t*-test

Daily snack consumption was associated with increased levels of DMFT (correlation coefficient = 0.215, $p = 0.019$) and PI (correlation coefficient = −0.2, $p = 0.03$) in children. There was a significant correlation between dairy products consumption and the PD index (correlation coefficient = 0.217, $p = 0.017$).

The Association among Dental Caries and Sleep Pattern

The mean DMFT in children with appropriate and inappropriate sleep patterns was 5 ± 3.34 and 5.70 ± 3.11, respectively. Therefore, the mean DMFT was higher in children with inappropriate sleep patterns than in those with appropriate sleep patterns. However, there was no statistically significant relationship between DMFT and sleep patterns (independent *t*-test, $p = 0.346$) (Table 4).

Sleep pattern was associated with dental caries based on the ICDAS system. The ICDAS mean was significantly greater in children with improper sleep patterns (independent *t*-test, $p = 0.032$) (Table 4).

A significant positive correlation was observed between sleep anxiety (correlation coefficient = 0.206, $p = 0.024$) and dental caries (according to DMFT and ICDAS), as well as between sleep time resistance (correlation coefficient = 0.288, $p = 0.001$) and dental caries (according to DMFT and ICDAS) (Table 5).

Association among Periodontal Status and Sleep Pattern

Findings revealed that GI, PD, and PSR were significantly higher in the inappropriate sleep pattern group. Thus, there was a significant relationship between children's sleep patterns and GI, PD, and

Table 3: Association between nutritional factors and oral health behavior with dental and periodontal health

		DMFT	*ICDAS*	*PD*	*PI*	*GI*	*PSR*
Oral health behavior							
Mouthwash use per week (times)	Correlation coefficient	–0.031	–0.013	0.042	0.183*	–0.065	0.067
	p-value	0.734	0.889	0.648	0.045*	0.483	0.467
Daily flossing use (times)	Correlation coefficient	–0.164	–0.195	–0.085	–0.081	–0.224	–0.125
	p-value	0.074	0.033*	0.356	0.379	0.014*	0.173
Daily brushing frequency (times)	Correlation coefficient	0.005	–0.043	0.134	–0.135	–0.108	–0.087
	p-value	0.953	0.644	0.144	0.140	0.241	0.346
Daily brushing time (minutes)	Correlation coefficient	–0.041	–0.098	0.019	–0.192	–0.160	–0.127
	p-value	0.658	0.288	0.833	0.036*	0.080	0.168
Diet-related variables							
Daily snack consumption (times)	Correlation coefficient	0.215	0.110	–0.037	–0.200	–0.014	–0.142
	p-value	0.019*	0.234	0.688	0.030*	0.884	0.123
Daily fruit and vegetable consumption (times)	Correlation coefficient	0.025	0.106	0.052	–0.086	0.031	–0.113
	p-value	0.789	0.249	0.574	0.354	0.737	0.222
Daily dairy products consumption (times)	Correlation coefficient	0.108	0.159	0.217	–0.029	0.058	–0.049
	p-value	0.242	0.084	0.017*	0.750	0.531	0.593

*Statistically significant

Table 4: Correlation between sleep pattern with dental caries and periodontal status

Variables	*Criteria*	*Healthy sleep pattern* Mean ± SD	*Unhealthy sleep pattern* Mean ± SD	*p-value*
Dental caries	ICDAS	1.49 ± 1.48	2.43 ± 1.90	0.032^*
	DMFT	5.00 ± 3.34	5.70 ± 3.11	0.346^
Periodontal status	GI	0.19 ± 0.30	0.36 ± 0.40	0.033^*
	PD	1.43 ± 0.28	1.60 ± 0.28	0.020^*
	PI	0.99 ± 0.69	1.17 ± 0.66	0.277^
	PSR	0.15 ± 0.27	0.30 ± 0.34	0.028^*

*Statistically significant; ^independent *t*-test

Table 5: Correlation between sleep quality subsections with dental caries

		Bedtime resistance	*Sleep onset delay*	*Sleep duration*	*Sleep anxiety*	*Night wakings*	*Parasomnias*	*Sleep disordered breathing*	*Daytime sleepiness*
DMFT	Correlation coefficient	0.288	0.060	0.094	0.206	0.132	0.064	–0.068	–0.123
	p-value	0.001*	0.517	0.305	0.024*	0.152	0.485	0.460	0.182
ICDAS	Correlation coefficient	0.251	0.080	0.081	0.251	0.009	0.122	–0.066	–0.069
	p-value	0.006*	0.382	0.376	0.006*	0.920	0.186	0.477	0.451

*Statistically significant

PSR indices (independent *t*-test, $p = 0.033$, $p = 0.020$, $p = 0.028$, respectively). However, there was no significant association between PI criteria and sleep patterns (independent *t*-test, $p = 0.277$) (Table 4).

Discussion

This study investigates the potential association between dental caries, periodontal status, and sleep quality. According to the Academy of Sleep Medicine, children aged 8–12 should have 9–12 hours of regular sleep per night to ensure optimal health.[36] In this study, the mean sleep duration of children has been 8.93 compared to the recommended amount.

Correlation among Dental Caries and Sleep Pattern

According to the results of the current study, an association was found between inappropriate sleep patterns and increased severity of dental caries as assessed by the ICDAS. However, no statistically significant relationship was observed between sleep quality and dental caries based on the DMFT index.

International Caries Detection and Assessment System has higher sensitivity and specificity compared to the dmft/DMFT index, providing up to 43% more information regarding the detection of noncavitated lesions. Due to the prevalence of noncavitated lesions, the use of the dmft/DMFT index in children results in a substantial loss of crucial information and leads to an underestimation of the presence of the disease.[37]

Adequate sleep can contribute to maintaining a healthy immune system and promoting sufficient saliva production, thereby decreasing the risk of dental decay.[38,39] Numerous studies have shown that insufficient sleep quality can increase the risk of developing dental caries, as reflected by the ICDAS index in this study.[40–42] In this regard, Asaka et al. conducted a study revealing that children who sleep <8 hours per day had 1.5 times higher risk of dental caries.[43]

There are several plausible mechanisms to explain the observed association between sleep disorders and a higher prevalence of dental caries:

- Decrease in saliva pH and its buffering capacity.[39]
- Increase in the abundance of oral *Streptococcus mutans* bacteria.[41]
- Decrease salivary flow rate.[39,44]
- Elevated levels of inflammatory cytokines and salivary amylase activity.[39,45]
- Increases salivary glucose levels.[42,46]

Studies have shown that irregular or late bedtimes, as well as inadequate sleep duration, are independent risk factors for caries in early childhood.[42] Staying up late at night can potentially disrupt the circadian rhythm and lead to irregular sleep patterns, which may decrease saliva production. This decrease in saliva production can make it more challenging for the body to effectively neutralize the acids generated by oral bacteria, potentially contributing to an increased risk of caries.[39,47] A cohort study conducted by Alqaderi et al. reported that children who go to bed late had a higher incidence of dental caries compared to those who go to bed early.[48] Additionally, Watanabe et al. also confirmed that late bedtime was a risk factor for the creation of dental caries.[38] These findings are according to the current study, which established a positive correlation among sleep resistance and dental caries.

Disturbances in the circadian rhythm can cause a decrease in the secretion of melatonin, an essential hormone responsible for regulating sleep–wake cycles. These changes disrupt the delicate balance of oxidative biochemistry in saliva and contribute to the development and progression of dental caries.[39,49]

As mentioned earlier, no statistically significant relationship has been observed between sleep quality and dental caries based on the DMFT index. This is consistent with the findings of a study that found no correlation between sleep behavior problems and dental caries, as assessed by the DMFT index.[50] In contrast to the findings of our study, the results of a recent analysis by Chen et al. indicated that insufficient sleep is associated with an increased risk of caries according to the DMFT index in primary dentition.[40] Different criteria have been considered for assessing sleep in these studies. Chen et al. utilized self-reported hours of sleep, which may introduce a potential risk of memory bias. In contrast, we employed a standardized questionnaire to evaluate sleep quality. Additionally, the two studies differ in terms of population and age-group, which may partly explain the dissimilar findings.

The associations between negative sleeping habits and dental caries status suggest that sleeping habits should be investigated using other diagnostic methods to confirm these findings.

Correlation among Periodontal Status and Sleep Pattern

The main aim of the current research was to evaluate the association between sleep quality and periodontal status. In the present study, GI, PI, PD, and PSR indices were used to assess periodontal status. The results indicated that inappropriate sleep patterns were significantly associated with GI, PD, and PSR.

Although the relationship between periodontal diseases and sleep has been the subject of scientific investigation, this association has not yet been thoroughly explored in the pediatric population. Several studies have investigated the potential relationship between sleep disturbances and periodontal disease, but the exact mechanisms are not yet fully understood.[51] One proposed mechanism is the impact of sleep on the immune system, which may compromise the health of the periodontium.[52,53] Other possible hypotheses for the biological interactions between sleep status and periodontal diseases include changes in the balance of the immune system and periodontal microflora, insulin resistance, glucose intolerance, and the secretion of inflammatory cytokines [interleukin-6 (IL-6), tumor necrosis factor (TNF)-α] and C-reactive protein (CRP).[51,52]

Alqaderi et al. showed that shorter sleep duration was related to an elevated risk of gingivitis in 10-year-old Kuwaiti children.[46] Similarly, Lee demonstrated that teenagers, who sleep >5 hours per day have a 2.28 times higher risk of experiencing periodontal disease compared to those who sleep >8 hours per day. These results are consistent with the findings of the current study.[54]

Grover et al. found that individuals with gingivitis exhibited significantly poorer sleep quality compared to those with periodontal health, even after controlling for potential confounding factors.[55] Our results are also in line with a cross-sectional study that found an increase in gingival inflammation in individuals with sleep disorders.[56]

Karaaslan and Dikilitaş confirmed the relationship between sleep duration, sleep quality, increased clinical attachment loss (CAL), and PD. Their findings suggest that the severity and extent of periodontitis are related to poor sleep quality and short sleep duration.[57]

A study conducted by Singh et al.,[58] showed the association among sleep quality and chronic periodontitis. The results of their study revealed a positive and statistically significant relationship between sleep quality and various indices, including PD, PI, GI, and CAL. These findings suggest that sleep quality may play a major role in the development and progression of chronic periodontitis.

A study by Wiener is inconsistent with the findings of the present research and the aforementioned studies. There was no significant relationship between sleep duration and periodontitis, even after adjusted analyses. In Wiener's study, sleep duration was dichotomized into two categories—< 7 hours and 7 hours or more. This categorization combined individuals with both adequate sleep duration and long sleep duration into a single category, which may have diluted the potential harmful effects of long sleep duration.[59]

Our findings are also inconsistent with the study conducted by Saletu et al., which found no significant association between sleep quality and periodontal status. These results might have been influenced by different periodontal evaluation criteria and data collection methods. The use of partial-mouth periodontal examination could have significantly affected the potential for underestimating or overestimating the severity of periodontitis. Additionally, different categorizations of periodontal disease could impact the association between periodontitis and sleep quality. Finally, variations in population characteristics may contribute to the inconsistent results observed.[60]

Limitations

Our findings may have limited statistical power due to the relatively small number of participants. It is important to note that this research has focused specifically on children, which were living in one geographical region, and as a result, the findings may not be generalizable to others. Also, it is important to point out the possibility of unmeasured potential confounders, like snacking characteristics and timing.

This research was a cross-sectional study, which inherently restricted the ability to investigate the effects of time variables and measure causal relationships accurately.

Strengths

One of the strengths of this study is the consideration of lifestyle habits during childhood. Given that children develop cognitive skills during this stage, it is crucial to establish appropriate lifestyle habits. Moreover, we controlled the known confounders to enhance the validity of the study.

Another strength of this study, was the investigation of sleep patterns and dental caries relationship according to ICDAS index. This was the first study to explore this relationship using the ICDAS index. Additionally, we examined the association among sleep patterns and periodontal status according to PSR criteria, which was not been conducted in previous studies.

Conclusion

The findings of this study highlight those children with a higher prevalence and severity of dental caries and periodontal disease showed poorer sleep quality. These results may have broader implications for oral health promotion and the development of integrated preventive and therapeutic approaches targeting both oral health and sleep quality.

Clinical Significance

According to this study, children should be encouraged to get adequate sleep by their parents and the dentists. Furthermore, during dental caries and periodontal treatments and preventive planning for oral health in high caries risk children, sleep pattern could be considering as an effective factor.

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