eor.istanbul.edu.tr

Official Publication of Istanbul University Faculty of Dentistry

Eur Oral Res 2024; 58(2): 102-107

Original research

Presence of candida in the dental plaque and saliva of patients with severe early childhood caries and early childhood caries: a pilot study

Esra Özgöçmen[1], **Tuğba Yiğit**[2], **Hüseyin Haydar Kutlu**[3]

Purpose
The aim of this study is to evaluate the presence of candida, which is one of the etiological factors contributing to early childhood caries (ECC) and severe early childhood caries (S-ECC), in the dental plaque and saliva of children aged 6 years and younger.

Materials and Methods
Our study involved 60 participants who met the inclusion criteria. Based on clinical examinations, we divided them into three groups, each consisting of 20 children: S-ECC, ECC, and caries-free groups. We collected dental plaque and saliva samples from the children during clinic visits. In the laboratory, we assessed these samples for the presence of candida using the Liofilchem® – ChromaticTM Candida (Roseto degli Abruzzi, Italy) medium and identified Candida species.

Results
The presence of Candida in the saliva of children with S-ECC (40%) and ECC (30%) was statistically significant compared to children without caries ($p<0.05$). Observationally, we found a higher presence of candida only in the dental plaque of children with S-ECC (25%) and ECC (15%) compared to children without caries ($p>0.05$). In the S-ECC group, we detected *Candida albicans, Candida glabrata, Candida krusei,* and *Candida tropicalis in saliva,* while *Candida albicans* was found in dental plaque. In the ECC group, *Candida albicans, Candida glabrata,* and *Candida krusei* were detected, whereas *Candida* was not detected in children without caries.

Conclusion
It is important to consider the presence of *Candida* in both saliva and dental plaque, as it potentially plays a role in the pathogenesis of ECC. These findings suggest that identifying and preventing *Candida* colonization may be valuable for individual risk assessment and could contribute to reducing ECC.

Keywords: *Candida, dental plaque, caries, saliva*

Introduction

ECC is a global public health concern (1). Despite preventive strategies aimed at reducing tooth decay, over 600 million children are affected by ECC (1, 2). Early childhood caries (ECC) is defined as the presence of one or more decayed (non-cavitated or cavitated lesions), missing, or filled (due to caries) surfaces in any primary tooth of a child younger than six years old (1). Any sign of smooth surface caries in children younger than three years old indicates severe early childhood caries (S-ECC). Between ages three and five, one or more cavitated, missing teeth (due to caries) or filled surfaces in primary maxillary anterior teeth, or a score of ≥4 (age 3), ≥5 (age 4), or ≥6 (age 5) surfaces, constitutes S-ECC (3).

ORCID IDs of the authors: E.Ö. 0000-0002-8136-082X; T.Y. 0000-0002-8742-9031; H.H.K. 0000-0001-6616-046X

[1]*Private Practice in Pedodontics, Bursa, Türkiye*

[2]*Usak University, Faculty of Dentistry, Department of Pediatric Dentistry, Usak, Türkiye*

[3]*Usak University, Faculty of Medicine, Department of Medical Microbiology, Usak, Türkiye*

Corresponding Author: Esra Özgöçmen

E-mail: esraa.ozgocmen@gmail.com

Received: 7 February 2023
Revised: 9 May 2023
Accepted: 17 July 2023

DOI: 10.26650/eor.20241067980

How to cite: *Özgöçmen E, Yiğit T, Kutlu HH. Presence of candida in the dental plaque and saliva of patients with severe early childhood caries and early childhood caries: a pilot study. Eur Oral Res 2024; 58(2): 102-107.* DOI: 10.26650/eor.20241067980

The primary risk factors for ECC include substrate, host, microorganism, and time (4, 5). Streptococcus mutans is the most significant cariogenic microorganism associated with ECC, which is a biofilm-dependent disease (1, 4). The ECC flora also comprises Streptococcus mutans, Lactobacillus spp., Bifidobacteria spp., Actinomyces spp., Veillonella spp., Scardovia wiggle, and Candida spp. species (4). Candida spp. is an opportunistic pathogen that is commonly found in oral flora (6). Oral and systemic predisposing factors contribute to the pathogenicity of Candida, including poor oral hygiene habits, tooth decay, immunosuppression, malnutrition, a high-carbohydrate diet, long-term antibiotic therapy, cytotoxic therapy, and dental prosthesis (7, 8). Virulence factors such as adhesion, biofilm formation, germ tube formation, dimorphism, toxin production, enzyme synthesis, phenotypic switch, and the presence of genes encoding virulence are significant contributors to the pathogenicity of Candida (9, 10). Candida spp. affects the caries process due to its properties of carbohydrate fermentation, aciduricity, acidogenicity, adhesion to tooth surfaces, biofilm formation on hydroxyapatite surfaces, penetration of dentin tubules, and extracellular enzyme synthesis (9, 11, 12). Therefore, the increased levels of Candida in the oral flora of children with S-ECC and ECC suggest its potential role in ECC etiology (7). Moreover, considering the high incidence of Candida in dental plaque among individuals with S-ECC, it has been identified as a risk factor for S-ECC and has been shown to be a more reliable indicator of S-ECC than many behavioral factors (13).

Studies have reported a higher presence of Candida in the dental plaque and saliva of children with ECC compared to caries-free children (7, 14, 15). However, information regarding its presence in S-ECC is limited. Our study aimed to investigate the presence of Candida, which is among the etiological factors of S-ECC and ECC, in the saliva and dental plaque of children aged six years and younger. The null hypothesis is that early childhood caries does not exhibit any significant differences in relation to the presence of Candida.

Materials and Methods

Ethical statement

This study was conducted with the approval of the Uşak University Faculty of Medicine Non-Interventional Clinical Research Ethics Committee (Approval No. 148-01-16; 17.06.2020). The guardians of the children who participated in the study were informed about its purpose, and written consent was obtained.

Participants

The study involved 60 randomly selected children (32 boys, 28 girls) who visited the Uşak University Faculty of Dentistry Department of Pediatrics between June 2020 and August 2020. Participants were children aged 6 years and younger who met the following criteria: they were systemically healthy, had not taken any medication (steroids, antibiotics, antifungals, or immunosuppressive drugs) in the past 3 months, had no intraoral pathology, had not undergone previous dental treatment, did not use intraoral appliances, were cooperative, and agreed to participate in the study. We categorized them into three groups, each consisting of 20 children: The S-ECC group, the ECC group, and the caries-free group. The S-ECC and ECC groups were categorized based on recommended criteria (1, 3), while the caries-free group comprised children without caries.

Clinical examination

A single dentist conducted a clinical examination under artificial light using a dental mirror and a periodontal probe to record the number of caries in all groups. Additionally, we recorded the gingival index (16) and plaque index (17) based on predetermined criteria to assess the relationship between the presence of Candida and both plaque and gingival health.

Dental plaque and saliva collection

Dental plaque from the S-ECC and ECC groups was collected from carious surfaces using a sterile cotton swab, while that from the caries-free group was obtained from the labial surfaces of all teeth near the gingiva. Children were instructed not to eat for one hour before saliva collection. We collected one milliliter of unstimulated saliva from the children in the morning, between 10:00 and 11:00 a.m., by having them directly spit into Eppendorf tubes.

Microbiological assessments

Following the collection of samples from dental plaques, the cotton swab tips were placed in microcentrifuge tubes containing 100 µL of saline solution. These microcentrifuge tubes, containing dental plaque and saliva samples, were labeled, stored at -80°C, and transported to the microbiology laboratory following the protocol described by Thomas *et al.* (6).

Once all the samples had reached room temperature, dental plaque samples with a total volume of 500 µL were diluted using sterile saline. The diluted dental plaque and saliva samples were homogenized using a vortex. From each sample, 100 µL was inoculated onto ChromaticTM Candida chromogenic medium (Liofilchem®, Italy) and incubated at 35 °C for 48 hours. Candida colonies were identified according to the manufacturer's instructions. Green colonies were identified as Candida albicans, beige colonies as Candida glabrata, pink colonies with pale margins as Candida krusei, and blue colonies as Candida tropicalis (see Figure 1).

Statistical analysis

In this study, descriptive statistics, including numbers, frequency, standard deviations, means, maximum, and minimum values, were provided. The Shapiro-Wilk test was used to assess the normality of the data distribution. The independent samples t-test was employed to examine differences in means between two independent groups with a normal distribution. The Mann-Whitney U test was used to compare means between two independent groups without a normal distribution. The Kruskal–Wallis test was applied to examine the relationship between the averages of variables in cases with more than two independent groups and non-normal distribution. The Pearson chi-squared test was used for the analysis of categorical variables. In cases where

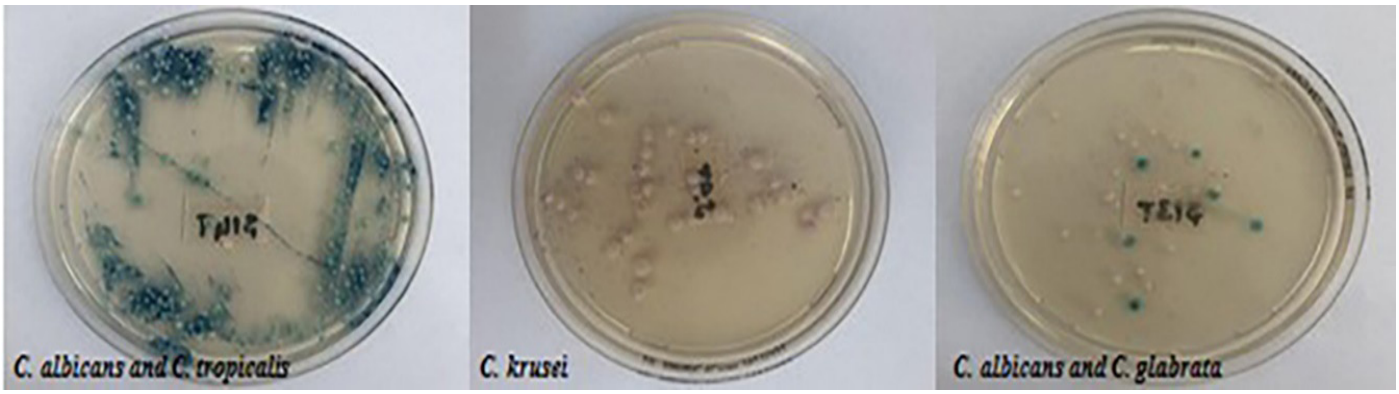

Figure 1. *Candida species seen on the chromogenic medium.*

the sample size assumption was not met, Fisher's Exact Test was performed. Data were analyzed using IBM SPSS Statistics 25.0 (IBM SPSS, Inc., NY, Armonk, USA). A p-value below 0.05 was considered statistically significant for the analysis.

Results

A total of sixty participants, comprising 32 boys and 28 girls, underwent examination. Subsequently, three distinct groups were established: ECC group, S-ECC group, and caries-free group. The characteristics of these groups are presented in Table 1. Based on our findings, the mean age of the ECC group was significantly higher than that of both the caries-free group ($p<0.05$) and the S-ECC group ($p<0.05$).

The presence and species of Candida in the children are detailed in Table 2. We observed significantly higher Candida levels in the saliva of the S-ECC and ECC groups compared to the caries-free group ($p<0.05$). However, there was no statistically significant relationship between the groups in terms of the presence of Candida in dental plaque. The presence of Candida in the dental plaque of the S-ECC group was only marginally higher than that in the ECC group, similar to its presence in saliva. Candida albicans, Candida tropicalis, Candida glabrata, and Candida krusei were detected in saliva, with Candida tropicalis being absent in dental plaque. Candida albicans was the most commonly identified Candida species in both the S-ECC and ECC groups. In the S-ECC group, it was found concurrently with Candida albicans in saliva, Candida krusei in two cases, Candida tropicalis in one case, and Candida glabrata in one case.

Table 1: *Gender, age and caries experience of the groups.*

Characteristic	S-ECC group	ECC group	Caries free group
Total number of children	20	20	20
Boys	10	12	10
Girls	10	8	10
Age in months			
Mean ± SD	56.35 ± 5.30	63.40 ± 8.91	50.80 ± 15.13
Median (min-max)	27.20 (42-63)	40.90 (42-71)	23.40 (17-70)
Number of caries			
Mean ± SD	8.55 ± 2.60	3.30 ± 1.52	0.00 ±0.00

Table 2: *Comparison of species distribution of Candida among S-ECC, ECC and caries-free groups*

	S-ECC group n (%)	ECC group n (%)	Caries free group n (%)	p value
Saliva				
Presence of *Candida*	8 (40)[a]	6 (30)[a]	0[b]	0.005*
Candida albicans	6 (30)[a]	4 (20)[a]	0[b]	0.026*
Candida krusei	2 (10)	1 (5)	0	0.766
Candida glabrata	1 (5)	1 (5)	0	1.000
Candida tropicalis	2 (10)	0	0	0.322
Dental plaque				
Presence of *Candida*	5 (25)	3 (15)	0	0.81
Candida albicans	5 (25)	2 (10)	0	0.058
Candida krusei	0	1 (5)	0	1.00
Candida glabrata	0	1 (5)	0	1.00

Fisher's Exact test, *p<0.05

When comparing the caries-free group with the ECC and S-ECC groups, a significant correlation was observed solely for the presence of Candida albicans in saliva ($p=0.026$). However, the distribution of all Candida species identified in dental plaque among the three groups was determined to be statistically nonsignificant ($p>0.05$).

Table 3 shows data on the presence of Candida in relation to the plaque index and gingival index. The plaque scores of the S-ECC and ECC groups were significantly higher than those of the caries-free group ($p<0.05$). A similar result was observed for the gingival index ($p<0.05$). However, just like the plaque index, there is also no significant relationship between the gingival index and the presence of Candida. It's worth noting that we excluded one child from the S-ECC group with a "3" gingival index code and one child from the caries-free group with a "2" gingival index code from the dataset due to an insufficient sample size for analysis.

Discussion

In recent years, evidence has emerged suggesting that Candida may play a role in the development of ECC (Early Childhood Caries) (7, 14, 18). Studies support a potential positive

Table 3: *Comparison of plaque index and gingival index among the groups*

		***Candida* Presence**	**0 (n%)**	**Gingival Index 1 (n\%)**	**2 (n\%)**	**p value**
Saliva	S-ECC Group	-	0	2 (18.20)	9 (81.80)	0.603
		+	0	3 (37.50)	5 (62.50)	
	ECC Group	-	0	4 (28.60)	10 (71.40)	1.00
		+	0	2 (33.30)	4 (66.70)	
	Caries Free Group	-	7 (36.80)	12 (63.20)	0	-
		+	0	0	0	
Dental Plaque	S-ECC Group	-	0	5 (33.30)	10 (66.70)	0.53
		+	0	0	4 (100.00)	
	ECC Group	-	0	5 (29.40)	12 (70.60)	1.00
		+	0	1 (33.30)	2 (66.70)	
	Caries Free Group	-	7 (36.80)	12 (63.20)	0	-
		+	0	0	0	
Total	S-ECC Group		0	5 (26.30)	14 (73.70)	0.000*
	ECC Group		0	6 (30.00)	14 (70.00)	
	Caries Free Group		7 (36.80)	12 (63.20)	0	
		***Candida* Presence**	**1 (n\%)**	**Plaque Index 2 (n\%)**	**3 (n\%)**	**p value**
Saliva	S-ECC Group	-	2 (16.70)	7 (58.30)	3 (25.00)	0.476
		+	0	7 (87.50)	1 (12.50)	
	ECC Group	-	3 (21.40)	11 (78.60)	0	1.00
		+	1 (16.70)	5 (83.30)	0	
	Caries Free Group	-	17 (85.00)	3 (15.00)	0	-
		+	0	0	0	
Dental Plaque	S-ECC Group	-	2 (13.30)	11 (73.30)	2 (13.30)	0.554
		+	0	3 (60.00)	2 (40.00)	
	ECC Group	-	3 (17.60)	14 (82.40)	0	1.00
		+	1 (33.30)	2 (66.70)	0	
	Caries Free Group	-	17 (85.00)	3 (15.00)	0	-
		+	0	0	0	
Total	S-ECC Group		2 (10.00)	14 (70.00)	4 (20.00)	0.00*
	ECC Group		4 (20.00)	16 (80.00)	0 (0.00)	
	Caries Free Group		17 (85.00)	3 (15.00)	0 (0.00)	

Fisher's Exact test, *p<0.05

correlation between oral Candida carriage and caries experience in children (19, 20). When Streptococcus mutans and Candida coexist in the oral biofilms of children with ECC, several factors come into play, including an increase in the extracellular polysaccharide matrix, bacterial accumulation, hypha formation of Candida, and increased biofilm virulence. These factors contribute to the development of rapid-onset caries, such as ECC (21). However, the number of studies comparing the presence of Candida in children with S-ECC (Severe Early Childhood Caries) and ECC is limited. Therefore, this study aimed to investigate the presence of Candida in children with S-ECC, ECC, and those without caries experience.

Lozano Moraga *et al*. (14) examined the unstimulated saliva of children and found that Candida was present in 35.5% of children without caries, 50% of children with moderate caries, and 72.2% of children with severe caries. Their findings indicated that Candida carriage increased with the severity of caries (14). Beena *et al.* (15) reported that Candida was detected in 84% of the dental plaque of children with ECC and 24% of children without caries, with this difference being statistically significant. In our study, significantly higher levels of Candida were observed in the saliva of the S-ECC and ECC groups compared to the caries-free group ($p<0.05$). The presence of Candida in dental plaque in the S-ECC and ECC groups was only marginally higher than that in the caries-free group ($p>0.05$). These findings align with the existing literature, suggesting that children with S-ECC and ECC tend to have more Candida in their oral flora com-

pared to children without caries. It has been proposed that factors such as adhesion, biofilm formation, penetration into dentinal tubules, and enzyme production may contribute to the cariogenicity of Candida (9, 11, 12). It should be noted that our study found Candida presence rates to be lower than those reported in other studies (14, 15). This difference might be attributed to various factors influencing Candida colonization. It is also worth mentioning that, while more Candida was observed in the saliva and dental plaque of the S-ECC group compared to the ECC group, this difference was not statistically significant. In studies with a larger number of participants, such distinctions between the groups may become statistically significant.

Under appropriate conditions, dental plaque creates a diffusion-limiting environment, encourages microbial accumulation, and serves as a physical scaffold that facilitates the adhesion of microorganisms to teeth (22). Saliva contains proteins that act as receptors for Candida species and play a role in Candida attachment to enamel and oral bacteria (23). Several factors have been reported to influence Candida colonization, including the diversity of molecules in saliva, saliva pH, saliva flow rate, saliva buffering capacity, high sugar concentration in carious lesions, carbohydrate-rich diets, oral hygiene practices, the severity of carious lesions, sample size, and the collection of plaque on the surface (11, 14, 22, 24). Our study has revealed that Candida is more prominently present in saliva than in dental plaque. Considering potential variations in Candida colonization based on the locations from which dental plaque is collected, saliva may serve as a superior marker for Candida detection in future studies.

Xiao *et al.* (25) reported that Candida albicans were detected in saliva and dental plaque of children with S-ECC at rates ranging from 77% to 83%, while in children without caries, the detection rate was only 12% to 6%. Furthermore, they identified 6% Candida tropicalis, 6% Candida glabrata, and 17% Candida krusei in the saliva and dental plaque of the S-ECC group. Similarly, Thomas *et al.* (6) found significantly higher levels of Candida albicans in the saliva and dental plaque of children with S-ECC compared to those without caries. In our study, Candida albicans were also found to be statistically significantly higher in the saliva samples of the S-ECC and ECC groups when compared to the caries-free group ($p<0.05$). It is worth noting that statistically significant results for other Candida species might be achievable in studies with larger sample sizes.

Several limitations in our study include the inability to perform advanced typing of Candida species, a small sample size, the sensitivity of sampling and laboratory practices. Further research is required to strengthen the evidence supporting the relationship between oral Candida and S-ECC and ECC. This research should aim to determine whether the presence of Candida can serve as a risk factor or risk indicator for the development of S-ECC and ECC and to understand whether Candida growth is influenced by factors involved in the caries process. Additionally, exploring differences in contagiousness among Candida species and understanding potential inter-species relationships is essential. The low presence of Candida in all groups compared to other studies and its absence in the non-carious group might be associated with various factors, including storage and transport conditions, and further investigation is needed.

Conclusion

The rates of Candida carriage in the S-ECC and ECC groups were higher than those in the caries-free group. This suggests that Candida may play a role in the initiation and progression of S-ECC and ECC. Further studies are required to investigate the potential vertical and horizontal transmission of Candida infections.

Türkçe özet: *Şiddetli Erken Çocukluk Çürüğü ve Erken Çocukluk Çürüğü Bulunan Hastaların Dental Plak ve Tükürüklerinde Candida Varlığı: Pilot Çalışma. Amaç: Bu çalışmanın amacı, erken çocukluk çağı çürüklerinin (ECC) ve şiddetli erken çocukluk çağı çürüklerinin (S-ECC) etyolojik faktörleri arasında yer alan Candida varlığının, çocukların dental plaklarında ve tükürüklerinde değerlendirmektir. Gereç ve Yöntem: Çalışmamız dahil edilme kriterlerini uygun 60 katılımcı ile gerçekleştirildi. Klinik muayeneye göre her biri 20 çocuktan oluşan, S-ECC bulunan, ECC bulunan ve diş çürüğü bulunmayan üç grup oluşturuldu. Çocuklardan diş plağı ve tükürük örnekleri alındı. Alınan örnekler, laboratuvarda, Candida varlığı ve Candida türleri açısından Liofilchem® – ChromaticTM Candida (Roseto degli Abruzzi, İtalya) besiyeri kullanılarak değerlendirildi. Bulgular: Candida varlığı, S-ECC (%40) ve ECC (%30) bulunan çocukların tükürüğünde, çürük olmayan çocuklara göre istatistiksel olarak yüksek görüldü ($p<0.05$). S-ECC (%25) ve ECC (%15) bulunan çocukların diş plaklarında, çürük olmayan çocuklara göre gözlemsel olarak daha fazla Candida belirlendi ($p>0,05$). S-ECC grubunda tükürükte Candida albicans, Candida glabrata, Candida krusei ve Candida tropikalis, diş plağında ise Candida albicans tespit edildi. ECC grubunda Candida albicans, Candida glabrata ve Candida krusei gözlenirken, çürük olmayan çocuklarda Candida görülmedi. Sonuç: ECC patogenezinde potansiyel rol oynayan, tükürük ve dental plakta Candida varlığının bireysel risk değerlendirmesi açısından önemli olabileceği düşünülmektedir. Çalışmanın sonuçlarına göre, Candida geçiş yollarının tanımlanmasının ve önlenmesinin ECC'yi azaltmada faydalı olabileceği görülmüştür. Anahtar kelimeler: Candida, dental plak, diş çürüğü, tükürük*

Ethics Committee Approval: This study was conducted with the approval of Uşak University, Faculty of Medicine, Non-Interventional Clinical Research Ethics Committee (Approval No. 148-01-16; 17.06.2020).

Informed Consent: The parents of the participants provided informed constent.

Peer-review: Externally peer-reviewed.

Author contributions: EO, TY, HHK participated in designing the study. EO, TY, HHK participated in generating the data for the study. EO, TY, HHK participated in gathering the data for the study. EO, TY participated in the analysis of the data. EO wrote the majority of the original draft of the paper. EO, TY, HHK participated in writing the paper. EO, TY, HHK has had access to all of the raw data of the study. EO, TY has reviewed the pertinent raw data on which the results and conclusions of this study are based. EO, TY, HHK have approved the final version of this paper. EO, TY guarantees that all individuals who meet the Journal's authorship criteria are included as authors of this paper.

Conflict of Interest: The authors declared that they have no conflict of interest.

Financial Disclosure: The authors declared that they have received no financial support.

References

1. Early Childhood Caries: IAPD Bangkok Declaration. Int J Paediatr Dent 2019;29:384-6. [CrossRef]

2. Chen KJ, Gao SS, Duangthip D, Lo ECM, Chu CH. Prevalence of early childhood caries among 5-year-old children: A systematic review. J Investig Clin Dent 2019;10:e12376. [CrossRef]
3. Drury TF, Horowitz AM, Ismail AI, Maertens MP, Rozier RG, Selwitz RH. Diagnosing and reporting early childhood caries for research purposes. A report of a workshop sponsored by the National Institute of Dental and Craniofacial Research, the Health Resources and Services Administration, and the Health Care Financing Administration. J Public Health Dent 1999;59:192-7. [CrossRef]
4. Tanner AC, Mathney JM, Kent RL, Chalmers NI, Hugles CV, Loo CY, et al. Cultivable anaerobic microbiota of severe early childhood caries. J Clin Microbiol 2011;49:1464-74. [CrossRef]
5. Gupta P, Gupta N, Pawar AP, Birajdar SS, Natt AS, Singh HP. Role of sugar and sugar substitutes in dental caries: a review. ISRN Dent 2013;2013:519421. [CrossRef]
6. Thomas A, Mhambrey S, Chokshi K, Chokshi A, Jana S, Thakur S, et al. Association of oral Candida albicans with severe early childhood caries- a pilot study. J Clin Diagn Res 2016;10:109-12. [CrossRef]
7. De Carvalho FG, Silva DS, Hebling J, Spolidorio LC, Spolidorio DM. Presence of Mutans streptococci and Candida spp. in dental plaque/dentine of carious teeth and early childhood caries. Arch Oral Biol 2006;51:1024-8. [CrossRef]
8. Patel M, Shackleton JT, Coogan MM. Effect of antifungal treatment on the prevalence of yeasts in HIV-infected subjects. J Med Microbiol 2006,55:1279-84. [CrossRef]
9. Abacı Ö, Haliki A. Candida albicans'ın virulans faktörleri. Orlab On-Line Mikrobiyoloji Dergisi 2004;2:1-8. Available from: http://www.mikrobiyoloji.org/pdf/702040901.pdf
10. Iwata K. Fungal toxins as a parasitic factor responsible for the establishment of fungal infections. Mycopathologia 1978;65:141-54. [CrossRef]
11. Qiu R, Li W, Lin Y, Yu D, Zhao W. Genotypic diversity and cariogenicity of Candida albicans from children with early childhood caries and caries-free children. BMC Oral Health 2015;15:144. [CrossRef]
12. Sen BH, Safavi KE, Spangberg LS. Colonization of Candida albicans on cleaned human dental hard tissues. Arch Oral Biol 1997;42:513-20. [CrossRef]
13. Cvanova M, Ruzicka F, Kukletova M, Lipovy B, Gachova D, Izakovicova Holla L, et al. *Candida* species and selected behavioral factors co-associated with severe early childhood caries: Case-control study. Front Cell Infect Microbiol 2022;12:943480. [CrossRef]
14. Lozano Moraga CP, Rodríguez Martínez GA, Lefimil Puente CA, Morales Bozo IC, Urzúa Orellana BR. Prevalence of Candida albicans and carriage of Candida non-albicans in the saliva of preschool children, according to their caries status. Acta Odontol Scand 2017;75:30-5. [CrossRef]
15. Beena MS, Peedikayil FC, GufranAfmed MB, Chandru TP, Soni K, Dhanesh N. Comparison of Candida species isolated from children with and without early childhood caries: A descriptive cross-sectional study. J Indian Soc Pedod Prev Dent 2017;35:296-300. [CrossRef]
16. Löe H. The gingival index, the plaque index and the retention index systems. J Periodontol 1967;38:610-6. [CrossRef]
17. Silness J, Loe H. Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition. Acta Odontol Scand 1964;22:121-35. [CrossRef]
18. Bulut G, Sorguç Y. Oral kandida sıklığı ve türlerinin şiddetli erken çocukluk çağı çürüğü ile ilişkisi: Mikrobiyolojik in-vivo çalışma. İzmir Dr Behçet Uz Çocuk Hast Dergisi 2020;10:219-24.
19. Klinke T, Guggenheim B, Klimm W, Thurnheer T. Dental caries in rats associated with Candida albicans. Caries research 2011;45:100 -6. [CrossRef]
20. Talay T, Odabaş M. Çürük oluşumunda candida ve non-candida türlerinin etkisi. Selcuk Dental Journal 2022;9:352-8. [CrossRef]
21. Falsetta ML, Klein MI, Colonne PM, Scott-Anne K, Gregoire S, Pai CH, et al. Symbiotic relationship between Streptococcus mutans and Candida albicans synergizes virulence of plaque biofilms in vivo. Infect Immun 2014;82:1968-81. [CrossRef]
22. Hajishengallis E, Parsaei Y, Klein MI, Koo H. Advances in the microbial etiology and pathogenesis of early childhood caries. Mol Oral Microbiol 2017;32:24-34. [CrossRef]
23. O´Sullivan JM, Jenkinson HF, Cannon RD. Adhesion of Candida albicans to oral streptococci is promoted by selective adsorption of salivary proteins to the streptococcal cell surface. Microbiology 2000;146:41-8. [CrossRef]
24. Yang XQ, Zhang Q, Lu LY, Yang R, Liu Y, Zou J. Genotypic distribution of Candida albicans in dental biofilm of Chinese children associated with severe early childhood caries. Arch Oral Biol 2012;57:1048-53. [CrossRef]
25. Xiao J, Moon Y, Li L, Rustchenko E, Wakabayashi H, Zhao X, et al. Candida albicans carriage in children with severe early childhood Caries (S-ECC) and maternal relatedness. PLoS One 2016;11:e0164242. [CrossRef]