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Candida albicans in Children with Early Childhood Caries: Scoping Review

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Abstract: *Early Childhood This scoping review aims to summarize scientific evidance regarding the presence, quantity, and role of Candida albicans in children with ECC and caries-free. A literature search was conducted using the Pubmed and Google Scholar database using the Preferres Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method. Both databases yielded 339 journals. All journals were then screened for eligibility, leaving six journals that met the research criteria. The results showed that C. albicans plays a significant role in the development of ECC, with a higher prevalence of C. albicans in children with ECC. Further research with longitudinal design is needed to improve understanding of etiology, prevention, and management of ECC.*

Keywords: *Early Childhood Caries, Caries-Free Children, Candida albicans*

Introduction

Various studies have shown that *Streptococcus mutans* (*S. mutans*) and *Lactobacillus* are considered the main oral microbiome causes Early Childhood Caries (ECC), but the involvement of *Candida albicans* (*C. albicans*) in the occurrence of ECC has not received much attention. Childeren with ECC had a higher prevalence of *C. albicans* than caries-free according to a number of studies. However the results are inconsistent, which may occur due to the cross-sectional design and variations in sampling techniques (Fakhruddin et al., 2020; Hajishengallis, 2017; Kim et al., 2021; Man, 2024; Xiao, 2018).

This raises the question of whether there has been a cross-kingdom interaction between *C. albicans* and caries-causing bacteria that makes *C. albicans* a secondary agent in the occurrence of ECC and increase the severity of ECC (Fakhruddin et al., 2020; Hajishengallis, 2017; Kim et al., 2021). *C. albicans* has the ability to produce extracellular hydrolases such as hemolysins, phosholipases, acidic hydrolases and Dnases which will damage the organic structure of tooth components (Alkhars, 2021; Fakhruddin et al., 2020; Lobo et al., 2019)

The purpose of this scoping review is to conduct a literature search regarding the involvement of *C. albicans* in the etiology ECC. In particular, by comparing the quantity of *C. albicans* in children with ECC and caries-free.

Furthermore, this scoping review is expected to increase understanding regarding the involvement of *C. albicans* in the occurrence of ECC, which can then lead to more comprehensive ECC prevention and management strategies.

The result of this study will be categorised according to age group, location, study design, and outcome. It is hoped that it will provide an overview of how C. albicans' role in ECC and recommendations for further research.

Methodology

This study used a scoping review method to examine the prescence of *C. albicans* in children with ECC compared to children who were caries-free. Population, Concept, Contex (PCC) criteria were used to direct the focus of the study. In this study, the population studied was children with ECC; the concept was the presence of *C. albicans*; and the context was the quantity of *C. albicans* in children with ECC and caries-free. The initial step was to identify and collect literature from databases such as PubMed and Google Scholar. The keywords ((Early childhood caries) OR (ECC)) AND ((*Candida albicans*) OR (*C. albicans*) OR (Oral candida) were used in a Boolean search method. This search was conducted between September and December 2024 to obtain the most recent and relevant research.

The selection process for research journals was carried out using the Preferres Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram as a reference in accordance with predetermined inclusion and exclusion criteria. Inclusion criteria included observational studies such as cohort studies, case-control studies, and cross-sectional studies. Journals that focuses on in vitro research, animal research, or thet did not sddress the relationship between *C. albicans* and ECC were excluded from the analysis.

Result and Discussion

The results obtained 339 journals from the search engines PubMed and Google Scholar. Ten duplicate journals were discovered out of the 339 journals, leaving 329 kuornals after duplication was removed. Of the 329 journals, 229 journals were excluded based on titles and abstracts that did not match the research topic, resulting in 100 filtered journals. The obtained journals were filtered again based on exclusion criteria, resulting in 38 journals that met the criteria. Of the 38 journals, there were 32 journals that were not relevant to the research, namely *C. albicans* journals with animals as research subjects, resulting in 6 journals that met the inclusion criteria and were used for the study (Figure 1).

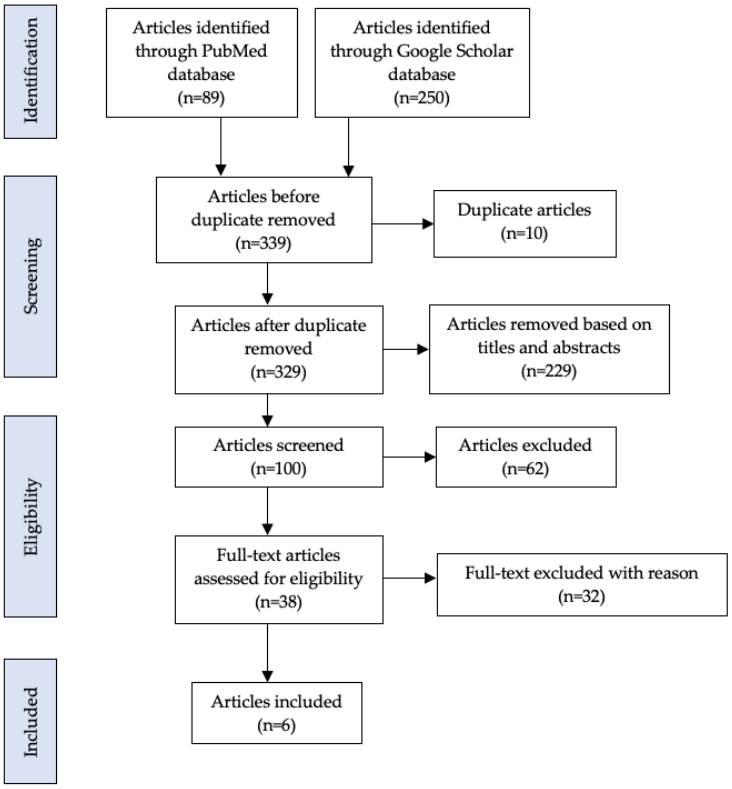

Figure 1. PRISMA diagram

After that, six journal that met the inclusion criteria and sutable for research were than categorised according to the title, name of the researcher and year, research field, study design, sample size, and finding. Six journals that showed a higher incidence of *C. albicans* in children with ECC than caries-free children were found during the literature search (Table 1).

Table 1. Extraction Table

No	Author, Year	Title	Research Area	Study Desain	Sample	Result
1.	Thomas ann, et al (2016)	Association of Oral Candida albicans with Severe Early Childhood Caries, A Pilot Study	Gujarat, india	cross-sectional study	n = 40	- Although *C. albicans* can be regarded as a normal commensal in the oral cavity, research has shown that it is present in 23,7% to 89% of children with caries and 7% to 21% of caries-free. - *C. albicans* is responsible for the cause and development of caries in children due to

						immature immune system
2.	Esra Özgöçmen, et al (2023)	Presence of candida in the dental plaque and saliva of patients with severe early childhood caries and early childhood caries: a pilot study	Istanbul, Turki	cross-sectional study	n = 60	- The presence of *C. albicans* in the saliva of children with S-ECC (40%) and ECC (30%) was significantly higher compared to caries-free - A higher quantity of *C. albicans* was found in the dental plaque of children with S-ECC (25%) and ECC (15%) compared to caries-free (p>0,05)
3.	Beena MS, et al (2017)	Comparison of Candida species isolated from children with and without early childhood caries: A descriptive cross- sectional study	Kannur, India	Cross-sectional study	n = 100	- Candida was present in 84% of children with ECC and 24% of caries-free - There is a strong correlation between ECC and the presence of Candida. The development of ECC is also significantly influenced by non-albicans Candida (NAC). Virulence factors such as phospholipases may be responsible for Candida's pathogenecity in ECC development
4.	Vanessa C. W. Man, et al (2024)	The Prevalence of Candida albicans and Malassezia globosa in Preschool Children with Severe Early Childhood Caries: A Case-Control Study	Basel, Switzerland.	Cross-sectional study	n = 80	- Saliva and plaque samples from children with caries were more likely to contain *C. albicans* than those from caries-free group. - The incidence of ECC is closely associated with *C. albicans*
5.	Shakuntala Siddaiah, et al (2024)	Microbiological Evaluation of Herbal Extracts against Candida	Karnataka, India	In Vitro Study	n = 60	- The presence of *C. albicans* was significantly higher in ECC (76,7%)

		albicans in Early Childhood Caries Patients: An In Vitro Stud				compared to caries-free (23,3%)
6.	Bachtiar, EW et al (2018)	Relationship between Candida albicans and Streptococcus mutans in early childhood caries, evaluated by quantitative PCR	Indonesia	Cross-sectional Study	n = 30	- *C. albicans* and *S. mutans* were found in children with ECC and caries-free, but children with ECC had higher numbers of *C. albicans* and *S. mutans* - In the children with ECC, the number of *C. albicans* was found to be higher in saliva than in dental plaque. - *C. albicans* can increase the number of *S. mutans* by truggering gtfB mRNA in ECC biofilm

Discussion

This study examines the presence of *C. albicans* in children with ECC and caries-fee caries. Several studies shown that *C. albicans* is more frequently found in the the oral cavity of children with ECC compared with caries-free. *C. albicans* interacts with *S. mutans* to form a cariogenic biofilm that can increase the risk of ECC, because *C. albicans* can produce acid and increase the metabolic process of sugar. In addition, *C. albicans* has ability to adhere to host cells, thus indicating that *C. albicans* has role in the development of ECC (Thomas, 2016). Thomas et al. (2016) investigated the relationship between *C. albicans* and ECC. The results shows that *C. albicans* is responsible for the cause and development of caries in children. Exopolysaccacharide (EPS) produce by *C. albicans* can lead to biofilm containing more *S. mutans*, increasing microbial numbers and infection rates (Thomas, 2016).

Esra Özgöçmen et al (2013) conducted a study to determine the prescence of C. albicans in thr palque and saliva of children with S-ECC and ECC. The results showed that the presence of *C. albicans* in the saliva of children with S-ECC (40%) and ECC (30%) was significantly higher compared to caries-free ($p<0.05$). Additionaly, children with S-ECC (25%) dan ECC (15%) had greater levels of *C. albicans* in their dental plaque than caries-free ($p>0.05$). This indicates that saliva has a higher concentration of *C. albicans* than dental plaque. Protein found in saliva serce as receptors for certain species of Candida, facilitating their adherence to oral mucosa and enamel (Ozgocmen, 2024).

Children with ECC and caries-free have significantly different salivary pH level according to research conducted in Switzerland by Vanessa et al in 2024. Low salivary pH (5.5) can create a favorable environment for *C. albicans* and can enhance *C. albicans*' ability

to contribute to caries development (Xiang, 2023). A decrease in the pH of the oral cavity (5,5) can create a favorable environment for *C. albicans*. When the pH of the mouth is below 5,5, the acidification previously carried out by *S. mutans* can decrease drastically to pH 4,2 so that the demineralization process occurs (Xiang, 2023).

The results of Vanessa et al.'s study is consistent with those of Shakuntala et al.'s study (2024), which found that caries-free children had a higher average saliva pH and stronger buffer capacity than children with ECC. Additionally, Shakuntala et al. reported that children with ECC had a considerably greater prevalence of *C. albicans* (76,7%) than caries-fress (23,3%) (Siddaiah, 2024).

According to research conducted by Bachtiar et al. (2018), children with ECC had more *C. albicans* and *S. mutans* than caries-free. By inducing gtfB mRNA in ECC biofilms, *C. albicans* enhance the quality of *S. mutans* (Bachtiar, 2018). Beena MS et al. state that cariogenic properties of *C. albicans* are probably influenced by its capacity to create acid, penetrate dentinal canals, and its enzymatic activity that can break down collagen. These factors allow *C. albicans* to damage tooth hard tissue and accelerate the demineralization process, thus it can be concluded that *C. albicans* contributes significantly to the development of caries (Beena, 2017).

A limitation of this study is that does not generate new research data, as its results depend on the quality of previous research data. Futhermore, the scoping review method is exploratory and descriptive, so it is not intended to analyze in-depth relationships.

Conclusion

The result of this scoping review indicated that children with ECC have more *C. albicans* than caries-free. This finding streghthens the evidance that *C. albicans* is more than just a commensal of the oral microbilme but plays an important role in the pathogenesis of ECC. Therefore, ECC prevention and management should consider strategies that balance the oral microbiome as a whole, not just bacterial control. Further longitudinal designs research is needed to elucidate causal relationships.

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