

A Systematic Review of the Causes Diagnosis and Treatment of Early Childhood Dental Caries

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ABSTRACT: *The current study sought to systematically review the existing literature to identify the risk factors, diagnosis, and treatment aspects of early childhood dental caries. A critical literature search was performed to screen and capture those relevant to the topic of study. The methodology used in this study was a systematic design that involved screening 1576 articles from PubMed and Google scholar. Data relating to the study design, setting, definition of outcomes measure, the source population's inclusion and exclusion criteria, and the methodological design quality using the Newcastle Ottawa Scale. Among the identified studies, 1238 articles were excluded based on the limitations and risk factors of early childhood dental caries. Examining reports base on the treatment of dental caries identified 56 studies. Further screening of the references of the identified studies identified three studies that addressed early childhood dental caries. Additional screening of the articles found only 12 articles that discussed three more pieces from the screening reference lists of the identified themes. Data collected from the current study were analyzed using the arithmetic percentage analysis with charts and graphs. The survey results show that cariogenic microorganisms, diet and environmental factors are the significant risk factors for childhood dental caries. The study concludes that pediatric dentists should build a common consensus on encouraging.*

Keywords: *Childhood dental caries; pediatric caries, caries diagnosis, caries lesions, treatment of caries, preschools children caries.*

1. INTRODUCTION

Dental caries is a term used to denote the results, signs and symptoms of localized chemical dissolution of the tooth surface triggered by energy-releasing activities. This activity occurs in the tooth biofilms or what Kawashita et al. (2011) refer to as dental plaque,

which provides a cover to the affected region of the tooth. The existing dental caries patterns seem different in children between the ages of one to two and those in older age groups. Tham et al. (2015) report that dental caries affects the primary maxillary incisors and first primary molars that resemble the pattern of teeth eruption in young children. The tooth decay rate and the growth of dental caries depending on the duration within which the tooth has been present and exposed to caries.

The onset of early childhood dental caries is characterized by the development of white spot lesions in the upper primary incisors along the gingival margin. The Affected teeth may also show the presence of cavitations lesions in the affected areas. In instances where caries remains unattended, they can progress and cause destruction, decay, or tooth removal. According to Peiyan et al. (2021), the occurrence of caries in childhood is highly correlated to primary and permanent dentitions in older ages. Dental caries is a prevalent disease that affects teeth and causes more widespread health consequences. Americano et al. (2017) reported that children with dental caries tend to grow slower than those free from the disease. Also, young children with dental caries tend to be underweight due to the disease's pain, which causes their declination to eat.

Childhood dental caries has been classified as a microbial disease despite the role played by dietary in its manifestation. The condition is a worldwide phenomenon that has wreaked havoc in disadvantaged populations despite their ethnicity, culture or race (Kawashita et al., (2011). The existing literature has pointed and categorized childhood dental caries related to socio-demographic factors, dietary factors, lack of parental education, lack of access to dental care and general oral hygiene. Al Ayyan et al. 2018 reported that the existing literature highlighted these risk factors are significantly essential in managing and treating childhood dental caries even though researchers have not analyzed the degree to which various risk factors related to childhood dental caries.

The presence of carcinogenic bacteria facilitates the decay process involved in dental caries. These bacteria are further divided into two major groups; the mutants streptococci and the lactobacilli species, which produces acids as they metabolize fermentable carbohydrates. The most prevalent acids responsible for dental caries include lactic, acetic, formic and propionic, which have been evidenced to dissolve the minerals which make up the enamel and the dentine (Ismail & Sohn, 2009). The process of tooth decay is facilitated by bacterial, which produce acid as a by-product of their metabolism activities and can thrive in acidic environments. Despite the complications and prevalence of dental caries in modern days, the disease can be prevented.

2. LITERATURE REVIEW

The existing literature categorizes dental caries as the most prevalent disease among young children aged five to seventeen. Childhood dental caries was recorded to be five times more common than asthma among young children and seven times more common than hay fever. The health issues associated with the severity and magnitude of childhood dental caries calls for a better understanding of the causes, diagnosis and treatment of the disease. The disease is associated with poor oral health among children, even though some authors such as Ismail and Sohn (2009) lists socioeconomic levels as a significant risk factor.

The causes and risk factors associated with childhood dental caries have been discussed widely across the globe. For instance, Kawashita et al. (2011) listed the risk factors that may cause childhood dental caries in children aged between one to three years. The author presented that cariogenic microorganisms, diet, and environmental factors are the existing risk factors for childhood dental caries. The authors noted that *Streptococcus mutans* (SM) and *Streptococcus sobrinus* were the primary microbial initiators of caries in young

children. *Lactobacillus* was also found to contribute to the progression of the lesions which develop in teeth but not in their start. The *Streptococcus Mutans* (SM) metabolizes sugars deposited on the surface of the enamel, hence initiating demineralization of the tooth's upper surface (Al-Bluwi, 2014). In a review conducted by Alzamah (2017), the bacterial causing agent *Streptococcus mutans* (SM) was found to be transmitted vertically and horizontally. The authors noted that vertical transmission involved sharing the bacterial from the maternal parent or caregiver. Horizontal transmission of the microbial *Streptococcus mutans* (SM) occurs due to the prevalence of neonatal factors.

A review carried out by Al-Bluwi (2014) identified dietary factors as an additional risk factor to childhood dental caries apart from microbial bacteria. A high prevalence of dental caries has been found to occur mostly among children who have high-sugared drinks. The presence of sugary foods on the teeth' surface will catalyze SM and lactobacilli acidic reactions hence causing further demineralization of the tooth surface. According to Tham et al., 2015, childhood diets rich in breast milk or cow milk are less cariogenic than other forms of diet. The review conducted by the authors showed a declining trend throughout. In a study conducted by Khan (2014) to examine the prevalence of dental caries in primary teeth among a 2-20 years population in the United Arab Emirates, most dental caries was found to be more on primary teeth than on permanent teeth.

According to Anil and Anand (2017), childhood dental caries can also be triggered by environmental factors. These ecological factors entail the general maternal hygiene practised by the parents or caregivers to the child. The microbial bacterial, which causes childhood dental caries, can be removed through proper oral hygiene. Consequently, children's should start receiving oral hygiene immediately after the first primary teeth begins to erupt. Environmental factors also entail the socioeconomic group of the child. In a study conducted by Gaur & Nayak (2011), these factors may include poverty levels, education level, age, ethnicity, deprivation and dental insurance coverage.

The existing literature also denotes specific diagnostics criteria and procedures for childhood dental caries. Barder et al. (2001) argue that the current growth in sophistication of interventions and ways to manage childhood dental caries has seen a simultaneous increase in methods of diagnosing carious lesions. The existing literature points out that the diagnosis of dental caries has been primarily a visual process. An inspection and review of radiographs followed this process to ensure that accurate results are obtained. According to Folan & Olatubosun (2018), clinicians have also used tactile information obtained through dental explorer to diagnose dental caries. The authors also argue that the advancement and use of more sophisticated machines such as fibre-optic transillumination (FOTI) and digital imaging still depend on the clinician's interpretations. This is far away from other modernized diagnosis tic criteria, which involves using digitalized radiograph images that offer the first assessment cues supplemented or supplanted by quantitative measurements.

Ismahil and Sohn (2009) conducted a systematic review to analyze the existing evidence on dental caries diagnosis critically. The authors presented wide variations between the studied case studies when it came to the diagnostic criteria of childhood dental caries. Besides, the authors also established that caries that attacks the maxillary incisors is one of the significant patterns that are observed in preschool going children. The authors conceded that there was a need to develop consensus on the various methods and diagnostic criteria for dental caries. The existing literature has also pointed at multiple treatment methods for childhood dental caries. According to Raphael & Blinkhorn, the treatment of childhood dental caries is based chiefly on fluoride treatments. However, clinicians should focus on ensuring that individuals prevent maternal childhood transmission, dietary control feeding, especially those with high amounts of sugar, and maintain good oral health. According to Colak et al. (2013), childhood dental caries could also be treated through

3. RESEARCH METHODS

3.1 Systematic Review

The current study utilized a systematic review design by searching various databases such as Google Scholar, Pubmed, Ebscohot and Scopus. The intensive literature search focused on identifying papers published between 2015 to 2021 and were relevant to the topic of study. This study's search strategy included papers with abstracts that covered diagnosis, treatment, and management of childhood dental caries. The references in the identified documents were further screened to identify other sources that might have failed to be detected in the searched databases. Additionally, the titles and the references of the identified papers were further screened separately to identify any relevant documents that might have been omitted from the initial search. Further, the selected studies' full text was screened to pinpoint epidemiological studies that might offer further information on diagnosis, treatment, and childhood dental caries management. The keywords used in the search strategy were *Childhood dental caries, pediatric caries, diagnosis of caries, caries lesions, treatment of caries, preschools children caries*.

3.2. Inclusion Criterion

Studies included in the current research were supposed to be cross-sectional studies, healthcare publications, reports or ecological studies which assessed or reported the diagnosis, management and treatment of childhood dental caries. Secondly, all included studies had to have discussed either therapy, control, or diagnosis of early childhood (1-3 years) dental caries. Studies examining caries in older children or adult people were excluded from the final analysis. The study also included studies that compared caries in early childhood with later years in childhood. Studies with similar results were also deleted from the publications to be screened.

3.3 Data collection

Data used in the current study was extracted from the studies that met the inclusion criteria. Data relating to the study design, setting, definition of outcomes measure, the source population's inclusion and exclusion criteria, and the methodological design quality using the Newcastle Ottawa Scale (NOS) (Wells et al., 2019). Data outcomes were further screened extracted independently using a standardized data extraction form. The studies chosen' methodological quality was classified using classes with scores of seven or higher showing a high-quality methodology.

3.4 Data analysis

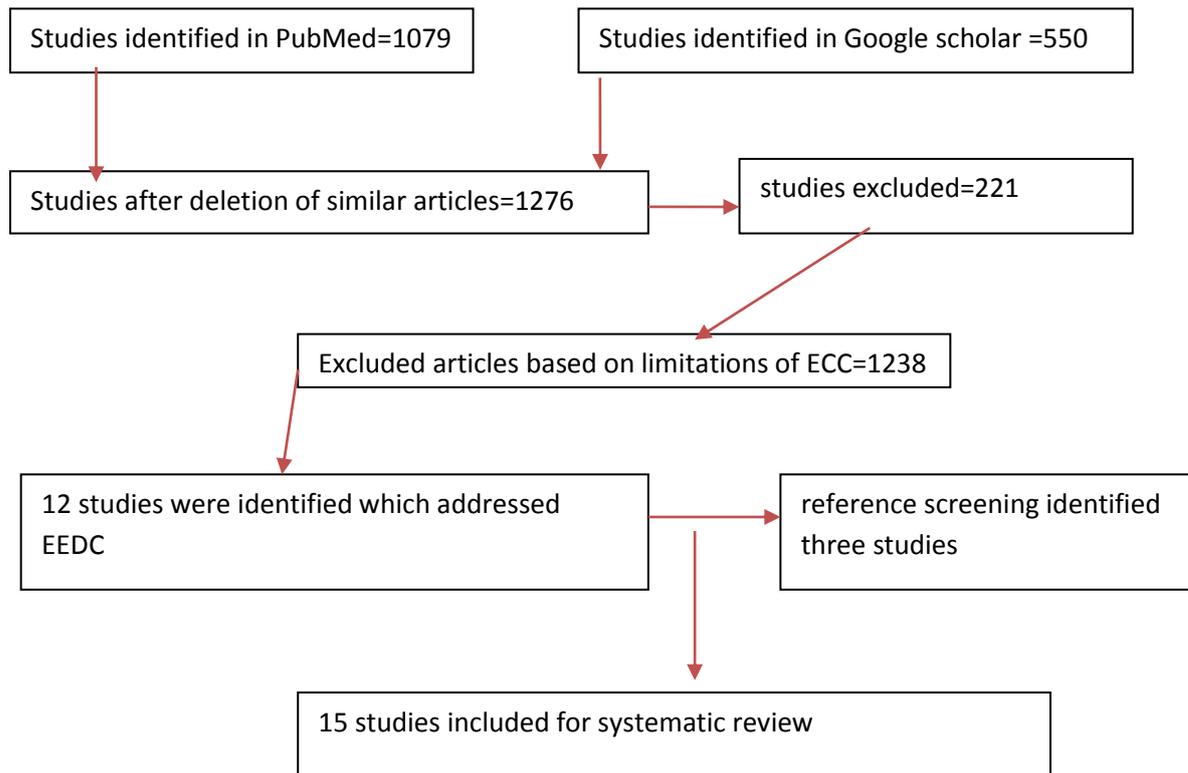
Data collected from the current study were analyzed using the arithmetic percentage analysis with charts and graphs. Data were obtained on the best diagnosis, management and treatment methods of early childhood dental caries. The data was then used to conduct arithmetic percentages using graphs and charts. The levels of heterogeneity were examined among the studies using percentage calculations. Given that the current research used data from already written sources, it is vital to consider and expect high I-square differences due to differences in sampling and methodological approaches.

3.5 Results

The current search identified 1079 articles that discussed early childhood dental caries in Pubmed. Besides, a search in Google scholar identified 550 articles. One thousand two hundred seventy-six pieces remained after a close screening which removed those articles

similar to the current study. In the reviews, approximately 95 studies were reviews, while 130 were case reports. One thousand two hundred thirty-eight articles were excluded based on the limitations and risk factors of early childhood dental caries. Examining themes base on the treatment of dental caries identified 56 studies. Further screening of the references of the identified studies identified three studies that addressed early childhood dental caries. Additional screening of the articles found only 12 articles which discussed with an addition of three more pieces from the screening reference lists of the identified themes, as shown in Figure 3.1 below.

Figure 3.1: Flow Chart Showing Literature Search and Study Selection



3.6 Characteristics of the Studies Included

All the papers included in the current study had the English language as their language of publication. Only twelve lessons of the fifteen included in the recent review were given a high rating on their methodology quality assessments. Most of the studies had inadequate data reporting methods. The remaining tasks were given a low score on methodological quality but were included in the study to avoid bias.

Table 3.: Characteristics of the Included Studies

Year of publication	Title	Scope	Type of Study
2015	<ul style="list-style-type: none"> Fluoridated milk for preventing dental caries. 	<ul style="list-style-type: none"> To assess the effects of milk fluoridation for preventing dental caries at a community level. 	<ul style="list-style-type: none"> Systematic Review

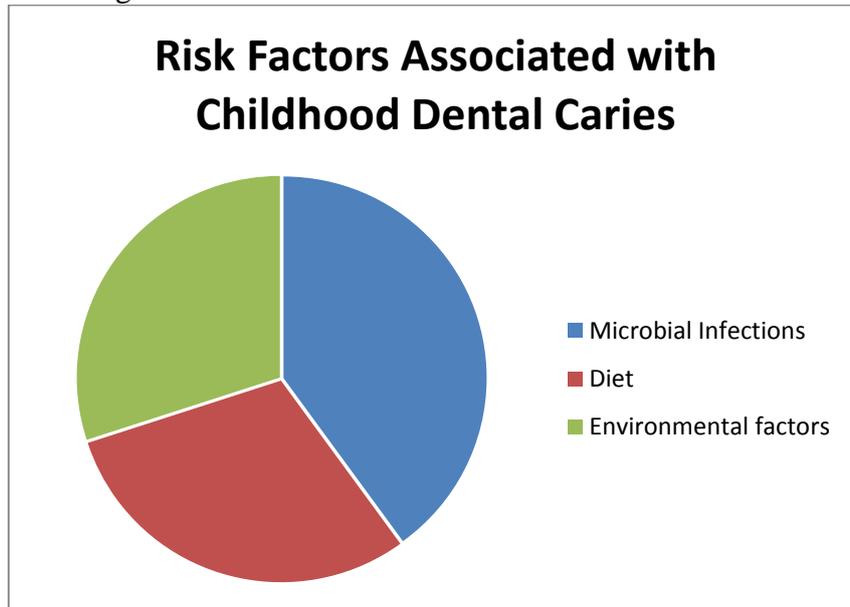
	<ul style="list-style-type: none"> • Detection and diagnosis of the early caries lesion • Advances in the microbial aetiology and pathogenesis of early childhood caries • Solving the aetiology of dental caries. <i>Trends in microbiology</i> 	<ul style="list-style-type: none"> • To discuss the currently available methods to detect early lesions amenable to prevention. • Microbial aetiology and Pathogenesis of childhood dental caries • 	<ul style="list-style-type: none"> • Quantitative • Qualitative
2016	<ul style="list-style-type: none"> • Prevalence and incident of dental caries • Prevention of dental caries through the use of fluoride—the WHO approach • Fluoride mouth rinses for preventing dental caries in children and adolescents. 	<ul style="list-style-type: none"> • To review the global prevalence and incidence of dental caries and periodontitis. • Use of fluoride in preventing dental caries • To determine the effectiveness and safety of fluoride mouthrinses in preventing dental caries in the child and adolescent population. 	<ul style="list-style-type: none"> • Qualitative • Quantitative • Systematic Review
2017	<ul style="list-style-type: none"> • Dental caries causes, factors and treatment • Interaction of lifestyle, behaviour or systemic diseases with dental caries and periodontal diseases: consensus report of group 2 of the joint EFP/ORCA workshop on the boundaries between caries and periodontal diseases • Nutrition, dental caries and periodontal disease: a narrative 	<ul style="list-style-type: none"> • Discussed the causes and diagnosis of dental caries • To systematically appraise the scientific literature to identify potential risk factors for caries and periodontal diseases • To provide a narrative review 	<ul style="list-style-type: none"> • Quantitative study • Systematic Review • Systematic Review

	<p>review</p> <ul style="list-style-type: none"> • Early childhood caries 	<p>of the role of macro-and micronutrients in dental caries, gingival bleeding and destructive periodontal disease</p> <ul style="list-style-type: none"> • Review and update the current knowledge about early childhood caries (ECC) and its aetiology, prevalence, risk factors, management, and preventive strategies. 	<ul style="list-style-type: none"> • Systematic Review
2018	<ul style="list-style-type: none"> • Relationship Between Early Childhood Caries and Anemia A Systematic Review • Early Childhood Caries. • 	<ul style="list-style-type: none"> • Reviewed the relationship between early childhood dental caries and anaemia • Assess Risk Factors associated with dental caries 	<ul style="list-style-type: none"> • Systematic review • Quantitative study
2019	<ul style="list-style-type: none"> • Early childhood caries epidemiology, aetiology, risk assessment, societal burden, management, education, and policy: Global perspective 	<ul style="list-style-type: none"> • To convey a global perspective of ECC definitions, aetiology, risk factors, societal costs, management, educational curriculum, and policy. 	<ul style="list-style-type: none"> • Quantitative
2020			

3.7 Childhood Dental Caries Risk factors

Among the studied papers, several risk factors and causes for childhood dental caries were identified. From the results, it can be observed that six studies (40%) listed microbial factors as a significant cause of dental caries in children. Besides, other risk factors such as environmental causes and diet were shown as important early childhood causes by 60% of the studies.

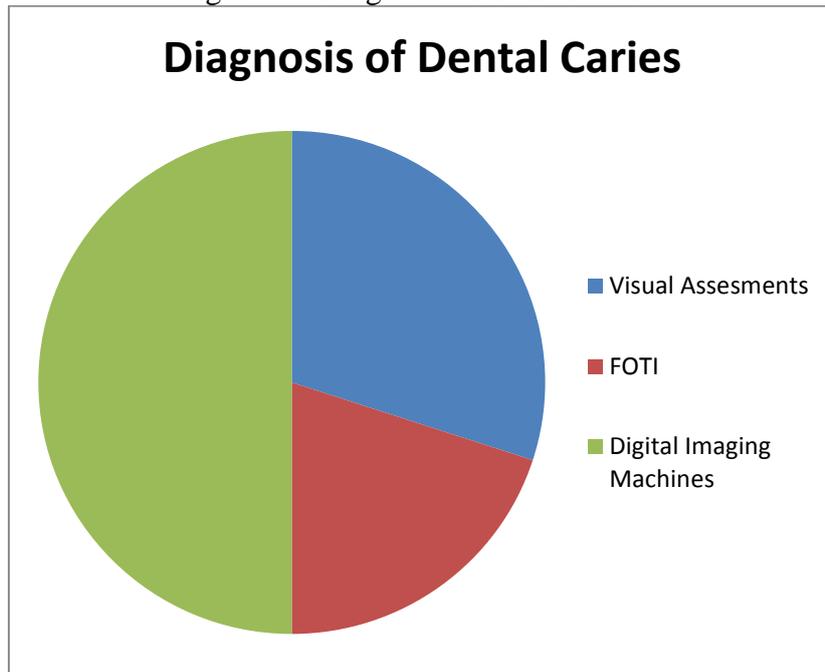
Figure 3.3: Risk factors associated with Dental Caries



3.8 Diagnosis of Dental Caries

Among the studied studies, 30% of the studies focused on clinician interpretation when it came to a diagnosis of dental caries. Among these studies, 90% believed that dental caries could be accurately determined by visual observations and comparing the results to radiology. 20% of the studies were based on fibre-optic transillumination (FOTI) and digital imaging, while 50.5% of the studies proposed that clinicians should focus on using digitalized radiograph images to offer the first assessment.

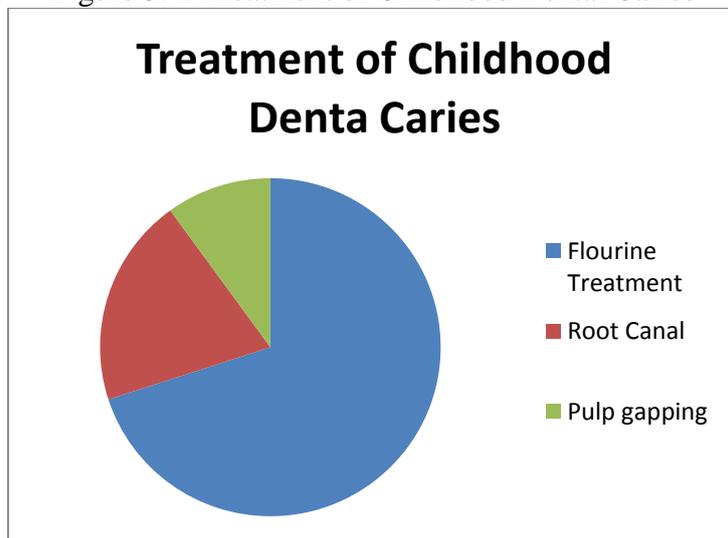
Figure 3.3 Diagnosis of Dental Caries



3.9 Treatment of Dental Caries

Among the fifteen studies included in this study, 70% suggested that childhood dental caries could be treated using fluorine. 20% of the studies indicated more complicated treatment methods such as root canal and extraction. Other 10% of studies suggested that clinicians should focus on filling and pulp capping.

Figure 3.4: Treatment of Childhood Dental Caries



4. DISCUSSION

The current study sought to understand the risk factors, diagnosis and treatment of childhood dental caries. A systematic review was carried out on the existing literature to identify studies that addressed the study's aim. Out of the 1576 studies identified, only 12 of them satisfied the study's inclusion criteria. The current study identified diet, environmental factors and the

presence of cariogenic microorganisms as risk factors to childhood dental caries. Additionally, the study found that in most diagnosis systems, the clinician's visual observation is the primary diagnostic criteria for childhood caries. Additionally, the current study's treatment options include fluorine, filling, root canal, and pulp gapping as primary treatment methods of childhood dental caries.

The findings of the current study depicted that diet, environmental factors such as parental feeding and exposure to the microorganism bacteria are the major risk factors to childhood dental caries. These findings concurred with the study conducted by Kawashita et al. (2011), who established that cariogenic microorganisms, diet, and environmental factors are the existing risk factors to childhood dental caries. The study's findings indicate that children whose parents are affected by the disease are at a higher risk of suffering from dental caries at their early ages in life. These findings were concurrent with the study results conducted by Alzamah (201), who argued that caries bacteria causing agents such as *Streptococcus mutans* (SM) were transmitted vertically from the parent to the child.

The current study established that most clinicians depend on their visual interpretations while diagnosing dental caries. These findings concur with the research conducted by Folayan & Olatubosun (2018), who found that as fibre-optic transillumination (FOTI) and digital imaging are increasing, the methods still depend on the interpretations of the clinician. Besides, the findings of the current study also depict an increasing trend in the use of digitalized images to offer the first assessments cues in the diagnosis of childhood dental caries. These findings are concurrent with the current literature. For instance, Hujoel & Lingström (2017) argued that clinicians should use modernized diagnosis methods such as digitalized radiograph images, which offer the first assessment cues supplemented or supplanted by quantitative measurements.

The current study's findings depict that fluorine treatment was the most preferred method when treating childhood dental caries. Other treatment methods such as root canal and pulp gapping could also be used to end childhood dental caries. The findings of the current study also depicted that controlling maternal transmission, children feeding habits, and young children's exposure to caries cariogenic bacteria could reduce the prevalence of childhood dental caries. These findings are consistent with the recommendations of Raphael & Blinkhorn, who argues that treatment of childhood dental caries is based chiefly on fluoride treatments, prevention of maternal childhood transmission, control of child dietary feeding, especially those with high amounts of sugar as well as maintaining good oral health.

4.1 Implications to Practice and Future Studies

The current study offers a way to diagnose and treat dental caries on the current diagnosis and treatment methods. Pediatric dental specialists need to build up the ideal approaches to build a common consensus on the risk factors, diagnosis criteria, and childhood dental caries treatment. Clinicians should focus on adjusting logical advances to obscure the gap between dental and restorative practices. Given that the current study focused on early childhood dental caries, future studies should review the existing literature with different age groups. Additionally, future studies should focus on comparing dental caries in early childhood and later ages in adolescence.

5. CONCLUSION

The impact of early childhood dental caries on an individuals' quality of life calls for clinicians and dentists to understand the causes, best diagnostic criteria and treatment procedures of the disease. As a result, pediatric dentists should focus on existing techniques of managing childhood dental caries to distinguish between indications and give the best

directives that can counter the disease's progress to a person's adult life. Families should comply with dental care, and regular dental follow-up even in the absence of subjective complaints indicates the patients observe oral hygiene. The elimination and treatment of childhood dental caries is a goal that requires close cooperation between dentists, children and families.

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