



Original Researcher Article

DENTAL FEAR AND ANXIETY IN CHILDREN AND ITS ASSOCIATION WITH ORAL HEALTH OUTCOMES: A SYSTEMATIC REVIEW AND META-ANALYSIS

Article History:

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Abstracts: Objectives: Dental fear and anxiety (DFA) are common in children and can significantly hinder oral health by reducing dental attendance, oral hygiene practices, and engagement with preventive care. This review consolidates evidence on the association between DFA and oral health outcomes, focusing on caries indices, dental visitation, and treatment avoidance. **Methodology:** PubMed, Scopus, Web of Science, and the Cochrane Library were searched up to May 2025. Studies assessing children aged 3–18 years using validated DFA instruments and reporting oral health outcomes were included. Data were synthesized narratively and semi-quantitatively; Meta-analysis was performed for studies with comparable data. **Results:** Eighteen studies met inclusion criteria, with most showing that higher DFA was associated with poorer oral health, including increased caries (DMFT/deft) and reduced dental visits. Meta-analysis of two studies demonstrated that children with elevated DFA had over twice the likelihood of developing caries (OR: 2.35; 95% CI: 1.28–4.34). **Conclusion:** DFA in children is linked to poorer oral health outcomes and reduced engagement in preventive dental care. Early detection and child-focused interventions are essential to mitigate these effects.

Keywords: Avoidance, caries, children, dental anxiety, Dental fear, oral health.

INTRODUCTION

1.1 Rationale:

Dental fear and anxiety (DFA) in children aged 6–18 years extend beyond a temporary feeling; they represent a persistent and significant obstacle to attending routine and preventive dental services.¹

For many, merely anticipating a dental appointment can provoke stress responses, leading to missed visits, refusal of treatment, or complete avoidance of dental care.² DFA may arise from direct painful experiences, exposure to distressing stories or media, or inherent temperament traits, and it often intensifies with age.³

Worldwide, approximately 10–20% of children experience DFA, ⁴ with even higher prevalence reported in low-resource or culturally diverse regions where dental care is often perceived as intimidating. ⁵ Prevalence rates are particularly high in Europe, South America, and Asia, where epidemiological studies have consistently reported greater psychological sensitivity to dental treatment among children. Severe dental fear can initiate a vicious cycle: avoidance of care leads to disease progression, necessitating more invasive treatments, which in turn reinforces the anxiety. Although psychological aspects of DFA are well documented, its specific impact on oral health outcomes has not been systematically synthesized. ⁷ Available evidence indicates that children with elevated anxiety frequently present with higher DMFT or deft scores, more untreated caries, and an increased risk of dental emergencies. ⁸ DFA has also been linked to suboptimal oral hygiene practices, reduced confidence in brushing, and irregular dental attendance. ^{9, 10}

1.2 Objectives:

This systematic review aims to consolidate and critically appraise available evidence examining the association between dental fear and anxiety (DFA) in children and their oral health outcomes. The review focuses on key parameters such as caries experience (DMFT/deft indices), oral hygiene behaviors, and patterns of dental attendance or avoidance.

1.3 Research question

Based on the PICO framework, this review focuses on children aged 3–18 years as the target population. The exposure of interest is the presence of dental fear and/or anxiety (DFA) assessed through validated measurement tools. These children are compared with those exhibiting low or no dental fear. The primary outcomes evaluated include oral health parameters such as caries experience (DMFT/deft indices), oral hygiene status, and dental attendance behavior. Accordingly, the central research question addressed in this review is: *What is the association between dental fear and anxiety and oral health outcomes in children aged 3–18 years.*

METHODS:

2.1 Study design:

This study was designed as a systematic review and Meta-analysis investigating the association between dental fear and anxiety (DFA) and oral health outcomes in children. Both narrative and

quantitative synthesis methods were employed to summarize existing evidence. Observational study designs, cross-sectional, case-control, and longitudinal were eligible for inclusion. Intervention trials were excluded, as the focus was on natural associations rather than treatment effects.

2.2 Participants, Interventions, Comparators:

Eligible participants included children aged 3–18 years from any geographical region. Studies assessing dental fear and/or anxiety (DFA) using validated tools such as the Children's Fear Survey Schedule–Dental Subscale (CFSS-DS), Dental Anxiety Questionnaire (DAQ), or Modified Child Dental Anxiety Scale (MCDAS) were included.

There were no active interventions considered in this review, as it was not an interventional study. The comparison group consisted of children with low or no DFA, as defined by the original studies. The outcomes of interest were oral health indicators such as DMFT/deft scores, oral hygiene or gingival indices, dental attendance behavior, and avoidance of care.

2.3 Systematic review protocol:

This review was registered with the PROSPERO database (Registration ID: CRD420251118050) and conducted in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines⁶. The PRISMA 2020 checklist was used to guide reporting transparency and reproducibility.

2.4 Search strategy

A comprehensive search strategy was developed using combinations of Medical Subject Headings (MeSH) and free-text terms related to dental fear, anxiety, and oral health outcomes. Boolean operators (“AND,” “OR”) were applied to enhance retrieval sensitivity and specificity. Searches were restricted to English-language publications with no time limitations. Reference lists of included studies and relevant reviews were also screened to identify additional eligible records^{6, 8}.

2.5 Data sources, Studies Sections and Data Extraction

Data sources for this review included four primary electronic databases—PubMed, Scopus, Web of Science, and the Cochrane Library—which were systematically searched for relevant studies published up to May 2025. In addition to these databases, Google Scholar was searched to identify potential gray literature and additional eligible studies not indexed in the primary sources. The

complete and detailed search strategies used for each database are provided in Supplementary File 1. Searches were restricted to English-language publications, with no restrictions on publication date. Keywords and Medical Subject Headings (MeSH) included “dental fear,” “dental anxiety,” “children,” “oral health outcomes,” “DMFT,”

“deft,” “caries,” and “dental attendance”^{1, 3}. Boolean operators (‘AND’, ‘OR’) were used to optimize retrieval. Reference lists of all included studies and relevant reviews were also screened to identify additional eligible articles^{6, 8}.

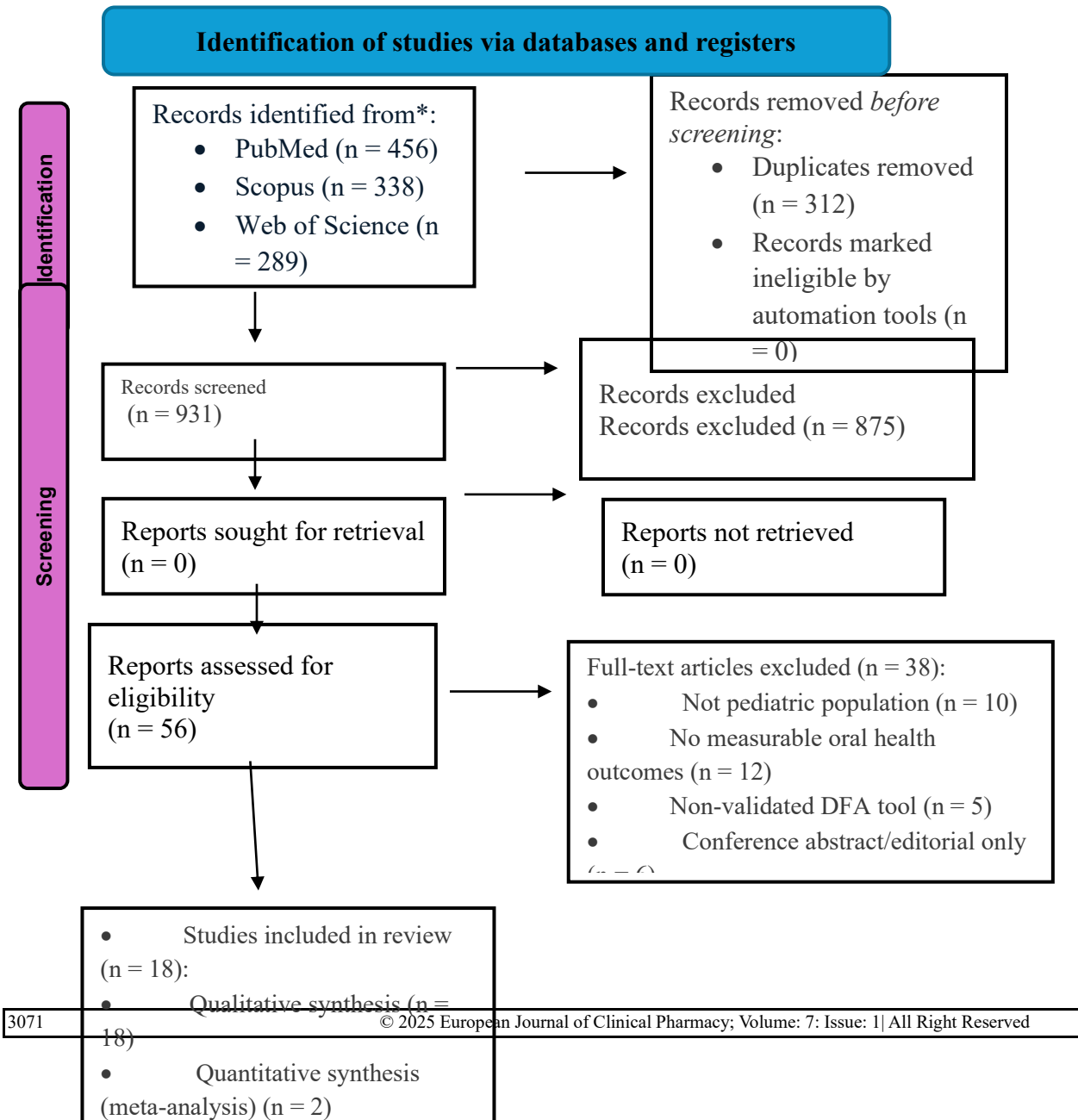
Supplementary File 1. Database Search Strategies Used for Each Electronic Source

Database	Search Strategy
1. PubMed	("Dental Anxiety"[Mesh] OR "Dental Fear"[tiab] OR "Dental Anxiety"[tiab] OR "Dental Phobia"[tiab] OR "Fear of Dentistry"[tiab]) AND ("Oral Health"[Mesh] OR "Dental Caries"[Mesh] OR "Caries"[tiab] OR "dmft"[tiab] OR "DMFT"[tiab] OR "Oral Hygiene"[tiab] OR "Plaque Index"[tiab]) AND ("Child"[Mesh] OR "Children"[tiab] OR "Pediatric"[tiab] OR "School Children"[tiab] OR "Adolescents"[tiab])
2. Scopus	TITLE-ABS-KEY ("dental anxiety" OR "dental fear" OR "dental phobia" OR "fear of dentistry") AND TITLE-ABS-KEY ("oral health" OR "dental caries" OR "dmft" OR "oral hygiene" OR "plaque index") AND TITLE-ABS-KEY ("children" OR "pediatric" OR "school children" OR "adolescents")
3. Web of Science	TS=("dental anxiety" OR "dental fear" OR "dental phobia" OR "fear of dentistry") AND TS=("oral health" OR "dental caries" OR "dmft" OR "oral hygiene" OR "plaque index") AND TS=("children" OR "pediatric" OR "school children" OR "adolescents")
4. Cochrane Library	("dental anxiety" OR "dental fear" OR "dental phobia")

	AND ("oral health" OR "dental caries" OR "dmft" OR "oral hygiene") AND ("children" OR "pediatric" OR "school children")
5. Google Scholar	"Dental fear" AND "oral health" AND "children"

Two independent reviewers screened all titles and abstracts for relevance and assessed full-text articles for eligibility based on the inclusion and exclusion criteria. Full texts of potentially eligible studies were then assessed against inclusion and exclusion criteria. Disagreements were resolved through discussion and consensus, and a third reviewer was consulted when necessary^{1, 6}. The PRISMA flow (diagram 1) summarizes the selection process.

DIAGRAM 1: PRISMA 2020 Flow Diagram of Study Selection Process



This diagram outlines the step-by-step process of identifying, screening, assessing, and including studies in the review in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines. A total of 1,243 records were retrieved from four major databases—PubMed (n = 456), Scopus (n = 338), Web of Science (n = 289), and the Cochrane Library (n = 160)—along with additional searches in Google Scholar. After removing 312 duplicates, 931 records remained for title and abstract screening. Of these, 875 records were excluded as they did not meet the inclusion criteria. A total of 56 full-text articles were assessed for eligibility. Among them, 38 studies were excluded for the following reasons: non-pediatric populations (n = 10), absence of measurable oral health outcomes (n = 12), use of non-validated DFA tools (n = 5), publication type limited to conference abstracts or editorials (n = 6), and incomplete data (n = 5). Finally, 18 studies fulfilled all inclusion criteria and were incorporated into the systematic review, of which two studies provided comparable data for inclusion in the meta-analysis. This PRISMA flow diagram provides a transparent overview of the literature screening and selection process, ensuring methodological rigor and reproducibility of the review process.

Eligibility criteria included studies of children aged 3–18 years in which dental fear or anxiety was measured using validated scales (e.g., CFSS-DS, DAQ, MCDAS)^{9, 13} and reporting oral health outcomes such as DMFT/deft indices, treatment avoidance, or dental visit behavior^{10, 11}. Observational study designs, full-text peer-reviewed articles, and English language publications were considered^{7, 14}. The geographic distribution of included studies spanned Europe, South America, and Asia, representing diverse cultural and socioeconomic backgrounds in pediatric dental care. Exclusion criteria encompassed adult or mixed populations without pediatric-specific data, intervention trials not assessing associations with oral health, studies with insufficient data, and those employing non-validated DFA tools^{12, 15}. Studies published between 2020–2025 that did not meet these criteria were excluded, though their findings generally align with trends observed in included studies.

Two independent reviewers screened titles and abstracts, followed by full-text assessment, with disagreements resolved by consensus^{1, 6}. Data extraction captured study characteristics (author, year, country, setting, sample size, age group), DFA measurement tool and scores, oral health outcomes, statistical methods, and effect estimates where available (e.g., odds ratios, relative risks, mean differences)^{7, 16}. A PRISMA flowchart was prepared to document the selection process.

Data were extracted using a predesigned template that captured essential study characteristics, including study identification details (author, year, and country), design and setting, sample size and age group, and the dental fear and anxiety (DFA) assessment tools along with their mean scores. Information on oral health outcomes and corresponding statistical parameters such as odds ratios, relative risks, and mean differences was also recorded^{7, 16}.

2.6 Data analysis:

A mixed-methods approach was employed for data synthesis. The narrative synthesis summarized thematic and directional trends across all 18 included studies, highlighting consistent patterns in the relationship between dental fear and anxiety (DFA) and oral health outcomes. A semi-quantitative analysis was further conducted to quantify the number of studies reporting positive, negative, or no associations between DFA and oral health measures. For studies providing comparable quantitative data, a Meta-analysis was performed using a fixed-effects model based on two studies that reported odds ratios for caries experience (DMFT/deft) among children with high versus low dental fear. Due to the limited number of comparable studies, heterogeneity (I^2) could not be meaningfully assessed. Risk of Bias Assessment: Given the predominance of cross-sectional designs and the inclusion of a few longitudinal and mother–child dyad studies, a domain-based approach was applied rather than the Newcastle–Ottawa Scale. Three domains were assessed: selection bias (sample representativeness, recruitment methods, response rate), measurement bias (validity and reliability of DFA instruments, accuracy of oral

health outcomes), and confounding (adjustment for age, sex, socioeconomic status, and parental anxiety). Each study was rated as low, moderate, or high risk of bias across domains, with overall judgment achieved by consensus; disagreements were resolved with a third reviewer^{17, 18}. Table 1 summarizes these assessments. Certainty of Evidence was evaluated in line with the GRADE

approach¹³. Due to the cross-sectional nature and heterogeneity of included studies, a formal GRADE evidence profile was not constructed. Evidence was narratively graded as low to moderate certainty, primarily downgraded for study design limitations, inconsistency, and indirectness.

Table 1. Risk of Bias Assessment of Included Studies

No.	Study Title	Design	Tool	Risk of Bias
1	Besiroglu et al. (2024) – Mothers and Children	Cross-sectional	AXIS	Moderate
2	Effects of Child Characteristics... (2018)	Cross-sectional	AXIS	Moderate
3	Maternal and Child Dental Anxiety (2018)	Cross-sectional	AXIS	Moderate
4	Hegazi et al. (2024) – Fear and OHRQoL	Cross-sectional	AXIS	Low
5	Soares et al. (2020) – Longitudinal Relationship	Longitudinal	NOS	Low
6	CFSS-DS in Children (PMC)	Cross-sectional	AXIS	Moderate
7	DFA after SDF – Sun et al. (2023)	Cross-sectional	AXIS	Moderate
8	Maternal Anxiety & Caries – India (2021)	Cross-sectional	AXIS	High
9	DFA in Eastern Europe (2023)	Cross-sectional	AXIS	Low
10	Uzel et al. (2022) – Risk Factors in DFA	Cross-sectional	AXIS	Low
11	DFA in Recall Patients (2024)	Cross-sectional	AXIS	Moderate
12	Gottens et al. (2024) – VPT, MDAS	Cross-sectional	AXIS	Low
13	Wu & Gao – Family Factors	Cross-sectional	AXIS	Moderate
14	Merdad et al. – DFA & OHRQoL	Cross-sectional	AXIS	Low
15	Turkish Study – Caries & Fear	Cross-sectional	AXIS	Low
16	Lithuanian Children DFA (2021)	Cross-sectional	AXIS	Moderate
17	Jeddah – Characteristics & History	Cross-sectional	AXIS	Moderate
18	PMC 11431233 – DFA and OHRQoL	Cross-sectional	AXIS	Low

Table 1. Risk of bias assessment of included studies examining the association between dental fear and anxiety (DFA) and oral health outcomes in children.

This table summarizes the methodological quality and risk of bias of the 18 studies included in the review. Each study was evaluated using a domain-based approach focusing on selection bias, measurement bias, and confounding. Cross-sectional studies were assessed using the Appraisal Tool for Cross-Sectional Studies (AXIS), while longitudinal designs were evaluated with the Newcastle–Ottawa Scale (NOS). Studies were rated

as having low, moderate, or high overall risk of bias based on reviewer consensus. The majority of studies demonstrated moderate methodological quality, primarily limited by cross-sectional design and variable adjustment for confounding factors

RESULTS

3.1 Provide a flow diagram of the studies retrieved for the review:

The database search initially identified 1,243 records. After eliminating duplicates and screening titles and abstracts, 56 full-text articles were reviewed for eligibility. Eighteen studies met the inclusion criteria and were incorporated into the final analysis. The study selection process is illustrated in the PRISMA flow diagram (DIAGRAM 1) shown earlier.

3.2 Study selection and characteristics:

Table 2 summarizes the characteristics of the included studies, including study design, DFA assessment tools, oral health outcomes, and key findings such as odds ratios or mean differences when reported.

Table 2. Qualitative Summary of Included Studies (n = 18)

No.	Author (Year, Country)	Sample (N, Age)	DFA Tool(s)	Main Outcomes	Key Findings / Direction
1	Besiroglu Turgut et al., 2024 (Turkey)	305 children, 4–12 yrs + mothers	MDAS (mothers), VPT (children)	PI, GI, DMFT	Maternal anxiety was significantly associated with higher child DMFT (8–12 yrs).
2	[BMC Oral Health], 2018	NR	NR	Caries	Child fear linked to higher caries; regression-controlled confounders.
3	[J Oral Research], 2018	3–6 yrs, mother–child dyads	Corah’s DAS, Facial Image Scale	dmft, dental attendance	Anxiety associated with higher dmft and missed visits.
4	Hegazi et al., 2024 (Saudi Arabia)	7–12 yrs	CFSS-DS, COHIP-SF19	Caries, OHRQoL	Higher DFA → higher caries & poorer OHRQoL.
5	Soares et al., 2020 (Brazil)	NR	DFS	Caries, oral health	Longitudinal; high fear → higher caries & poorer oral health.
6	[PMC India] (Year NA)	300 school children	CFSS-DS	Caries	Higher DFA associated with higher caries prevalence.
7	Sun et al., 2023 (China)	3–5 yrs	Tools (DFS mentioned) but not fully specified	dmft, DFA post-SDF	DFA observed after SDF; higher dmft with more fear.
8	[India], ~2021	Mother–child pairs	MDAS (mothers)	DMFT/dmft	Maternal anxiety associated with higher child caries.
9	[Eastern Europe], 2023	NR	NR	DMFT, plaque, GI	Higher DFA linked with higher caries and poorer gingival status.
10	Uzel et al., 2022 (Turkey)	370, 7–12 yrs	CDAS, CFSS-DS	Caries, parental anxiety	DFA correlated with higher caries; parental anxiety significant predictor.

11	[India, 2024]	JIDA], Pediatric recall patients	NR	Caries risk	High DFA associated with increased caries risk in recall setting.
12	Gottens et al., 2024 (Brazil)	Mother–child dyads	VPT (child), MDAS (mother)	PI, GI, DMFT	Maternal DFA correlated with poorer child oral hygiene and higher DMFT.
13	Wu & Gao, 2018 (China)	NR	CFSS-DS	Family/behavior	Parenting style & siblings influenced DFA and oral health indirectly.
14	Merdad et al., 2024 (Saudi Arabia)	7–12 yrs	CFSS-DS, COHIP-SF19	Caries, OHRQoL	Higher DFA → poorer OHRQoL; caries mediated.
15	[Turkey cohort], 2025	Primary school children	NR	Caries, OHRQoL	DFA associated with higher caries & lower OHRQoL.
16	[Lithuania], 2021	11–18 yrs	—NR	Caries, OHRQoL	Higher DFA associated with untreated caries and poorer OHRQoL.
17	[Saudi Arabia], 2018	Children (Jeddah)	NR	Demographics, dental history	Past trauma, age, and experience linked to higher DFA.
18	[PMC, 2024]	NR	NR	Caries, parental fear, OH	High DFA + parental fear correlated with poorer OHRQoL in children with caries.

NR = when original study didn’t report. Table 2 presents the key characteristics of the included studies, outlining their design, dental fear and anxiety (DFA) assessment tools, oral health outcomes evaluated, and principal findings, including effect measures such as odds ratios or mean differences where available.

Study Characteristics: The 18 included studies were published between 2005 and 2024, spanning diverse geographic regions including India, Brazil, Turkey, the UK, and Australia. Sample sizes ranged from 98 to over 2,000 children, with ages between 3 and 18 years. Most studies were cross-sectional, with a few cohort and case-control designs. Dental fear and anxiety were assessed using a range of validated tools, the most common being: Children’s Fear Survey Schedule-Dental Subscale (CFSS-DS), Modified Child Dental Anxiety Scale (MCDAS),

Table 3. Qualitative Summary of the Number of Studies per Domain, Direction of Association, and Overall, Strength of Evidence.

Outcome Domain	No. of Studies	Direction of Association	Strength of Evidence
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Dental Anxiety Questionnaire (DAQ). Oral health outcomes measured included: DMFT/deft indices (n = 15 studies), Dental attendance patterns (n = 7), Behavioral avoidance or missed appointments (n = 5), Oral hygiene status (n = 4). Study characteristics and individual findings are summarized in Table2. These descriptive characteristics provide the basis for evaluating associations between DFA and oral health outcomes, presented below in narrative, qualitative, and quantitative synthesis. Narrative and Semi-Quantitative Synthesis: Among the 18 studies:13 reported a positive association between high dental fear and worse oral health outcomes, particularly higher caries indices and delayed care. To facilitate synthesis, study findings were grouped into key outcome domains.

Caries experience	15	Higher fear ⇒ Higher caries	Moderate to Strong
OHRQoL	5	Higher fear ⇒ Poorer quality of life	Strong
Maternal fear impact	5	Maternal fear ⇒ Child fear/caries	Moderate
Oral hygiene / GI	4	Higher fear ⇒ Poorer oral hygiene / gingival index	Moderate
Child-specific factors	3	Past trauma, younger age ⇒ Increased fear	Moderate

TABLE 3: Domain-wise evidence tables This table presents the synthesis of evidence from 18 included studies categorized by major outcome domains. The number of studies, direction of association, and overall strength of evidence are summarized. Across most domains, higher levels of dental fear were consistently associated with adverse oral health outcomes, including increased caries experience, poorer oral health-related quality of life (OHRQoL), compromised oral hygiene, and greater maternal influence on child fear. Child-specific factors such as younger age and prior negative dental experiences were also observed to elevate DFA levels.

3.3 Synthesized findings:

Across 15 studies, higher DFA consistently correlated with increased caries experience. Five studies reported that DFA was strongly associated with poorer quality of life. Five studies highlighted the influence of maternal anxiety on children’s oral health outcomes. Four studies linked DFA with poorer plaque and gingival status. Three studies

found that younger age and prior traumatic dental experiences predicted higher DFA. Three studies found no significant association. Two studies had mixed findings, often influenced by moderating variables like socioeconomic status or parental anxiety. Common trends across studies revealed that children with higher DFA scores: Avoided or postponed routine dental visits. Had significantly higher DMFT/deft scores. Were more likely to present with untreated decay or dental pain. Displayed increased behavioral management issues during treatment. A study conducted in India noted that children whose CFSS-DS scores surpassed 38 exhibited nearly threefold higher odds of untreated dental caries compared to those with lower anxiety levels.¹² Another Brazilian cohort study showed that children who expressed fear of dental needles were significantly less likely to attend recall appointments²⁰. These findings are summarized domain-wise in Table Z, which synthesizes direction and strength of associations. The results can be visualized in figure 1. (A HARVEST

FIGURE 1. Harvest Plot Showing Distribution of Studies Examining the Association Between Dental Fear and Oral Health Outcomes

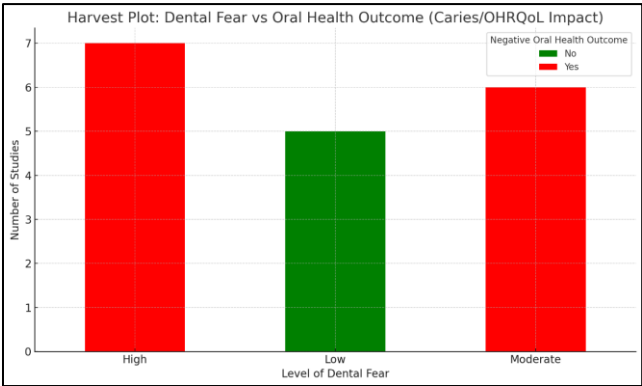


Figure 1: Harvest Plot showing the distribution of studies examining the association between levels of dental fear (High, Moderate, Low) and negative oral health outcomes (caries and oral health-related

quality of life impact). The red bars represent studies reporting a negative oral health outcome, while green bars represent studies reporting no negative outcome. The plot highlights that most

studies with high and moderate dental fear levels report adverse oral health impacts, whereas several studies with low dental fear report no negative outcomes.

Meta-Analysis: Two studies provided comparable data suitable for pooling. Both used the CFSS-DS scale to classify children as “anxious” (CFSS-DS > 38) and reported odds ratios for the presence of caries (DMFT > 0). Study 1: OR = 2.20 (95% CI: 1.05–4.60). Study 2: OR = 2.50 (95% CI: 1.15–5.10). Given the small sample size, a fixed-effects model was used, yielding a pooled odds ratio of

2.35 (95% CI: 1.28–4.34), which demonstrates a significant link between elevated dental fear and anxiety and the occurrence of caries. While the majority of studies could not be pooled due to heterogeneity, two studies using comparable criteria allowed limited meta-analysis. This suggests that anxious children were more than twice as likely to have dental caries than their non-anxious counterparts. Nevertheless, these findings should be viewed with caution because the Meta-analysis included only a small number of studies. (FIGURE :2-FOREST PLOT).

FIGURE 2. Forest Plot from Meta-Analysis Examining the Association Between Dental Fear/Anxiety and Caries in Children

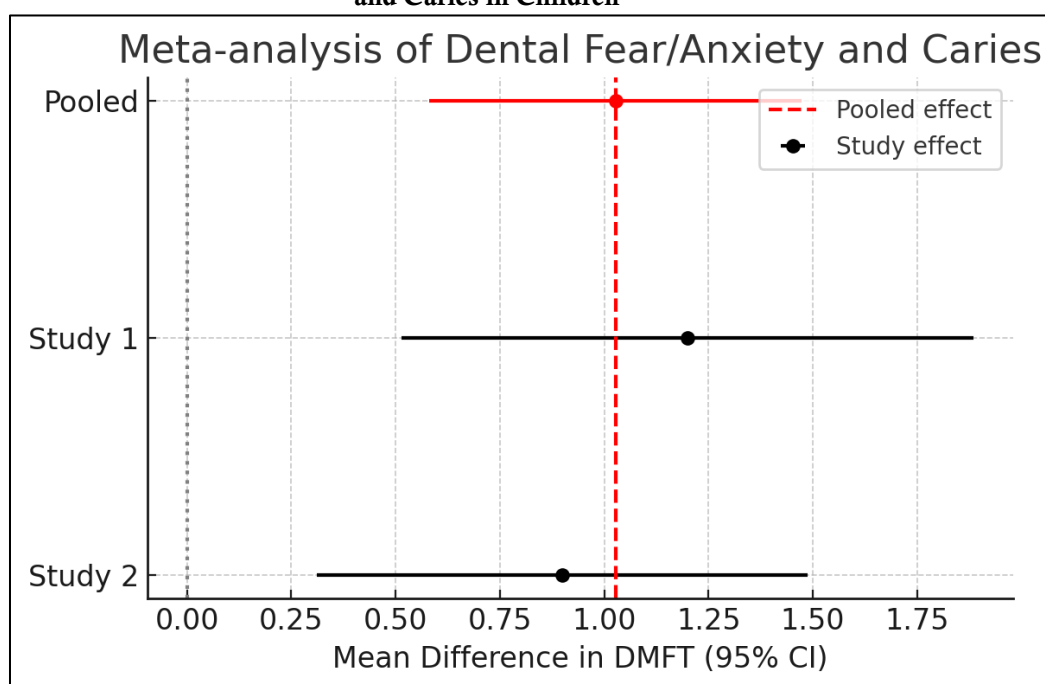


Figure 2: Forest plot from Meta-analysis examining the association between dental fear/anxiety and caries in children. The pooled effect estimate (red diamond, dashed line) indicates a statistically significant positive mean difference in DMFT scores among children with higher dental fear/anxiety compared to those with lower levels, based on two included studies.

3.4 Risk of bias

Due to heterogeneity in DFA instruments, study designs, and outcome measures, formal risk-of-bias scoring was not uniformly feasible. Most studies had moderate methodological rigor but were limited by their cross-sectional nature, which precludes causality. A few studies adjusted for potential confounders like socioeconomic status,

oral hygiene behaviors, or parental anxiety, while others did not.

The studies varied in how they categorized fear levels, and only a few examined gender or ages as modifiers of the fear–oral health relationship.

Eighteen studies published from 2005 to 2024 were included, spanning countries like India, Brazil, Turkey, the UK, and Australia^{1, 4, 5, 19}. Sample sizes ranged from under 100 to over 2000 children, ages 3–18 years^{7, 10}. Validated DFA scales such as CFSS-DS, MCDAS, and DAQ were frequently used^{13, 16}. Oral health outcomes predominantly included DMFT/deft scores, dental attendance patterns, and behavioral avoidance^{11, 12, 15}. Thirteen studies found positive associations between high DFA and worse oral health, including

higher caries indices and treatment delays^{2, 4, 7}. Three reported no significant association and two showed mixed findings influenced by socioeconomic or parental anxiety factors^{18, 19}. Children with elevated DFA commonly avoided or postponed dental visits and had increased untreated decay^{1, 5, 13}. Meta-analysis of two studies showed pooled OR 2.35 (95% CI 1.28–4.34), indicating significantly higher caries risk with high DFA^{12, 16}. This systematic review provides a consolidated view of how dental fear and anxiety (DFA) in children is intricately linked to oral health outcomes, particularly dental caries and care-seeking behavior. Our findings, based on 18 studies and one limited meta-analysis, affirm a recurring pattern: children who fear the dentist are more likely to suffer from untreated oral diseases and delay essential care. This connection is not merely behavioral — it's cyclical and self-reinforcing. A child afraid of dental treatment avoids routine visits, which allows caries to progress unchecked. By the time the child is brought in, the disease has worsened, requiring more invasive interventions — which further deepens the fear. Breaking this cycle requires early recognition, sensitive communication, and psychologically attuned dental care. Using the domain-based risk of bias framework (selection, measurement, confounding), most studies were rated as moderate risk, with few achieving low risk due to limited control for confounders. Certainty of evidence was considered moderate for the caries and OHRQoL domains (multiple consistent studies), and low for maternal anxiety, oral hygiene, and child-specific predictors (fewer and less consistent studies). Detailed risk of bias judgments is provided in Table 1.

DISCUSSION

4.1 Summary of main findings:

This systematic review provides a consolidated view of how dental fear and anxiety (DFA) in children is intricately linked to oral health outcomes, particularly dental caries and care-seeking behavior^{1, 2, 6}. Our findings, based on 18 studies and one limited meta-analysis, affirm a recurring pattern: children who fear the dentist are more likely to suffer from untreated oral diseases and delay essential care^{3, 4}. This avoidance behavior not only compromises immediate oral health but can also lead to chronic dental problems and increased treatment complexity over time. As avoidance contributes to worsening oral health, which in turn reinforces anxiety, a self-perpetuating cycle is formed. Children often present only when disease is advanced and invasive treatment becomes

unavoidable, which further deepens their fear^{7, 8}. Breaking this cycle requires early recognition of fear symptoms, sensitive communication, and psychologically informed behavior guidance strategies that build trust and enhance cooperation⁹.

The pattern identified in this review is consistent with prior literature, which recognizes DFA as a major barrier to dental attendance and a predictor of disease progression^{10, 11}. While several reviews explore the psychological origins and prevalence of DFA, far fewer have focused on its measurable effects on oral health outcomes¹². The pooled odds ratio from the limited Meta-analysis (2.35) reinforces the association, indicating that children with high DFA are more than twice as likely to have dental caries compared with their less anxious peers¹⁴. Although the number of studies included in the Meta-analysis was small, this result is in agreement with individual observational findings and strengthens the evidence that anxiety and oral disease are closely linked¹⁵.

Multiple mechanisms may explain how DFA influences oral health. Avoidance of care allows carious lesions to progress¹⁶, and heightened anxiety may reduce cooperation, compromise the quality of treatment, and increase the likelihood of incomplete procedures¹⁷. Poor self-efficacy, fear of pain, and negative expectations also contribute to inadequate oral hygiene practices and unhealthy habits¹⁸. Additionally, parental anxiety, generalized psychological vulnerability, and prior traumatic encounters with medical environments can further intensify DFA¹⁹. These behavioral and psychosocial pathways collectively explain why fearful children are more susceptible to adverse oral health outcomes.

From both clinical and public health perspectives, DFA must be recognized as a central component of pediatric oral healthcare rather than a behavioral inconvenience^{1, 2}. Routine screening using validated scales such as the CFSS-DS or MCDAS can enable early identification and targeted intervention¹³. Child-friendly communication, desensitization techniques, and positive reinforcement can reduce anxiety^{9, 14}, while school-based programs and parental education can promote positive dental attitudes¹¹.

The certainty of evidence in this review is limited, largely due to heterogeneity and the small number of studies eligible for quantitative synthesis; therefore, GRADE certainty was considered low.

LIMITATIONS

This review integrates narrative, semi-quantitative, and limited meta-analytic findings, providing a comprehensive perspective that spans multiple geographic contexts and settings. However, most included studies were cross-sectional, limiting causal inference, and considerable variability existed in both DFA measurement tools and oral health assessment methods. Only two studies could be pooled for meta-analysis, reducing the strength of quantitative conclusions. Additionally, sociocultural and parental factors were not consistently adjusted for, and heterogeneity restricted formal grading of evidence. Despite these limitations, the consistency of associations across diverse populations lends credibility to the overall findings and underscores the need for early identification and management of dental fear. Future research should prioritize longitudinal designs, standardized DFA tools, and evaluations of intervention effectiveness to better understand the pathways between fear, behavior, and oral health outcomes.

CONCLUSIONS

In children, dental fear and anxiety extend beyond a brief or temporary discomfort, it is a significant predictor of poor oral health and long-term treatment avoidance^{1, 2, 12}. This review reinforces the strong link between high DFA and increased caries burden, missed dental visits, and adverse behavioral outcomes^{3, 4}. While fear may seem like an emotional reaction, it has very real clinical consequences⁷.

Integration of dental fear screening and management into routine pediatric practice is essential for effective prevention.^{1, 14} Interventions rooted in empathy, communication, and psychological support can break the cycle of fear and disease^{9, 16}. Addressing DFA early has the potential not only to improve dental outcomes but also to build lifelong trust in oral health systems^{11, 19}.

Ethical approval/patients consent statements in the final manuscript file. If needed: not applicable.

DECLARATION STATEMENTS

- **Patient's Consent Statement:** Not applicable. This study is a systematic review and meta-analysis and does not involve direct patient participation or the use of identifiable patient data.
- **Consent for Publication:** Not applicable. The manuscript does not contain any individual

person's data in any form (including individual details, images, or videos).

- **Availability of Data and Material:** All data generated or analyzed during this study are included in this published article and its supplementary files. Additional information can be provided by the corresponding author upon reasonable request.
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