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REVIEW

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# Teledentistry for dental caries screening and preventive care in children and adolescents: a global scoping review

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**Abstract**

Dental caries is the most common chronic disease among children worldwide. Despite being largely preventable, disparities in access to care persist, particularly in low-resource and rural settings. Teledentistry offers a promising approach to bridge this gap by enabling remote screening, diagnosis, and preventive interventions. This scoping review aims to synthesize global evidence on the application of teledentistry for pediatric caries screening and preventive care, identifying implementation strategies, diagnostic accuracy, and challenges across diverse settings. This scoping review followed the Joanna Briggs Institute (JBI) methodology and the Preferred reporting system for systematic review and meta-analysis for scoping review (PRISMA-ScR) guidelines. A systematic search was conducted across four electronic databases (PubMed, Embase, Scopus, Web of Science) and gray literature sources from January 2015 till 31 May 2025. Studies were included if they focused on teledentistry for caries screening/prevention in children (0–18 years). Data were extracted using a standardized form. A narrative synthesis was performed, supported by tabular and visual summaries of key findings. Twenty-three studies were included from dental settings in high- and low-middle-income countries. Teledentistry demonstrated high diagnostic accuracy for caries detection, with store-and-forward and mobile health (mHealth) modalities showing sensitivity (44%–98.3%) and specificity (58%–100%). Non-dental personnel achieved reliable results post-training. Preventive applications, such as Artificial Intelligence (AI)-driven apps and school-based programs, improved oral health knowledge and access, particularly in underserved areas. Teledentistry is a promising tool for pediatric caries management, offering scalable solutions for early detection and prevention. However, equitable implementation requires addressing digital disparities, standardizing training, and fostering policy support. The pre-designed protocol for this review was established and registered in the Open Science Network (Reg. No. osf.io/fs56z).

**Keywords**

Teledentistry; Pediatric dentistry; Dental caries; Screening; Preventive care; Global health

## 1. Introduction

Dental caries remains the most widespread chronic disease among children globally [1, 2]. The Global Burden of Disease Study estimated that over 530 million children are affected by untreated dental caries in primary teeth, making it the most common untreated condition worldwide [3]. If left untreated, caries can lead to significant complications, such as pain, infections, malnutrition, absenteeism, and reduced psychosocial well-being [4].

Despite being largely preventable through timely risk assessment, behavior modification, and fluoride application, access to preventive dental care remains unevenly distributed. Children in low- and middle-income countries (LMICs) and underserved populations in high-income countries (HICs) face significant barriers, including geographic isolation, limited healthcare infrastructure, shortage of pediatric dental professionals, low oral health literacy, and financial constraints [5]. The COVID-19 pandemic further exacerbated these disparities by restricting in-person dental services, highlighting the fragility of conventional dental care systems [1]. Teledentistry has emerged as a promising, technology-driven approach to extend the reach of dental services, particularly for early caries detection and preventive counseling in pediatric populations [6].

Teledentistry, a subset of telehealth, is defined as the use of telecommunication technology to provide dental care, consultation, education, and public health interventions remotely [7].

It comprises various modalities, including synchronous (real-time interaction), asynchronous (store-and-forward), remote monitoring, and mobile health (mHealth). These modalities can facilitate screening, diagnosis, education, and referral in both community and clinical settings [4]. In pediatric oral health, teledentistry has been used in school-based screening programs, maternal-child health services, and mobile dental units to detect early signs of caries, deliver anticipatory guidance to caregivers, and promote oral hygiene behaviors [8, 9].

Several pilot programs in high-income settings have demonstrated the feasibility and cost-effectiveness of teledentistry. The "Virtual Dental Home" model in California, for example, successfully deployed mid-level dental providers in community sites to collect diagnostic data, which was remotely reviewed by dentists, leading to early intervention and reduced need for advanced treatment [10]. Similarly, school-based teledentistry initiatives in Australia have shown that mobile and asynchronous platforms can significantly improve access to preventive care among rural and indigenous children [11, 12]. In LMICs, although the adoption of teledentistry is still emerging, mHealth interventions using smartphones and instant messaging platforms have been piloted with encouraging outcomes, especially in India, Brazil, and Iran [13–15].

However, significant implementation challenges remain. Diagnostic accuracy is heavily influenced by image quality, device calibration, and user training [10, 16]. Additionally, ethical considerations, such as data privacy, consent, and legal accountability in remote care models, are yet to be comprehensively addressed in many jurisdictions [5]. Moreover, disparities in digital infrastructure, particularly in rural and low-income settings, may inadvertently exacerbate oral health inequities if not addressed through targeted policy and resource allocation [3].

The existing literature on pediatric teledentistry is expanding but remains fragmented, with limited synthesis of global evidence regarding its use specifically for caries screening and prevention. Previous reviews have either focused on teledentistry in general populations, evaluated treatment-based applications, or were geographically restricted [7, 8, 17–19]. As the global health community pushes toward digital health integration within Universal Health Coverage frameworks, there is a need for comprehensive evidence to inform scalable, equitable, and context-sensitive teledentistry interventions in pediatric oral health [1, 6].

This scoping review aims to address this gap by systematically mapping the global application of teledentistry for caries screening and preventive care among children. By identifying best practices, contextual challenges, and evidence gaps, this review seeks to inform researchers, policymakers, and clinicians about how teledentistry can be optimized to reduce the global burden of dental caries in children.

## 2. Material and method

The pre-designed protocol for this review was established and registered in the Open Science Network (Reg. No. osf.io/fs56z). The current scoping review was conducted in accordance with the methodological framework proposed by the Joanna Briggs Institute (JBI) for scoping reviews and reported following the Preferred reporting system for systematic review and meta-analysis for scoping review (PRISMA-ScR) checklist (**Supplementary material 1**) [20]. The review systematically mapped the existing global literature on the application of teledentistry for dental caries screening and preventive care in pediatric populations.

### 2.1 Research question

Following Population, context, and concept guidelines for scoping review, the research question developed was "What is known about the use of teledentistry for caries screening and preventive care among children and adolescents worldwide?".

Where, Population (P): Children and adolescents aged 0–18 years from any geographic, socioeconomic, or cultural background. Concept (C): Application of teledentistry technologies for dental caries screening (detection, diagnosis, risk assessment) and delivery of preventive care (oral hygiene instruction, fluoride therapy, dietary counseling, anticipatory guidance). Context (C): Global implementation in various settings, including school-based programs, community health clinics, rural and remote areas, low-resource environments, and both public and private healthcare systems.

### 2.2 Inclusion criteria

- Peer-reviewed original studies (quantitative, qualitative, or mixed methods).
- Studies published in the English language.
- Studies published from January 2015 to present to capture contemporary developments in teledentistry.

### 2.3 Exclusion criteria

- Studies not involving children or adolescents as primary subjects.
- Studies focusing exclusively on treatment or restorative dental care via teledentistry (not screening or prevention).
- Opinion, editorials, commentaries, reviews, and conference abstracts without sufficient data.

### 2.4 Search strategy

A comprehensive literature search was conducted across four electronic databases to identify relevant studies. The primary databases searched include MEDLINE (via PubMed), Embase, Scopus, and the Web of Science. These databases were selected to ensure a broad and inclusive search of peer-reviewed literature across disciplines related to pediatrics, dental public health, and digital health.

To supplement the electronic database search and capture gray literature, additional sources, such as Google Scholar, OpenGrey, and official websites of international health organizations, including the World Health Organization (WHO) and the Federal dental information (FDI) World Dental Federation, were also explored.

A preliminary search was conducted on MEDLINE (via PubMed) to identify relevant keywords, subject headings (MeSH terms), and appropriate search terms related to the topic. These terms were then refined and adapted for use in each database by incorporating Boolean operators and

database-specific syntax to ensure sensitivity and specificity of the search. The terminologies used in each database are presented in **Supplementary Table 1**.

## 2.5 Data screening

All identified records from the database and gray literature searches were imported into EndNote 20 for the purpose of de-duplication. The screening process was conducted in two distinct stages. In Stage 1, two reviewers (MA and SA) independently screened the titles and abstracts of all retrieved articles to identify potentially relevant studies based on the predefined inclusion criteria. In Stage 2, the full texts of selected articles were retrieved and reviewed in detail to determine their eligibility for inclusion in the scoping review. Any discrepancies or disagreements between reviewers at either stage were resolved through discussion, and if consensus could not be reached, a third reviewer (AS) was consulted to make the final decision.

## 2.6 Data extraction

A standardized data charting form was developed specifically for this review to ensure consistent and comprehensive extraction of relevant information. The form was pilot tested on a small sample of studies to assess clarity, completeness, and usability, and was refined as necessary. Two reviewers independently extracted data using Microsoft Excel (Version 2025, Microsoft Corporation, Redmond, WA, USA), ensuring methodological rigor and reducing bias in the data collection process. The data extraction was divided into three forms, (1) different caries detection methods; (2) preventive programs for dental caries reduction and education; and (3) specificity and sensitivity of the teledentistry programs. The data extracted had the following outcomes; for Table 1 (Ref. [10, 11, 14–16, 21–30]), Name of the authors/country/year, study design, sample population, teledentistry modalities (synchronous, asynchronous, mobile health (mHealth), or artificial intelligence (AI)-enabled platforms), technologies used, caries screening method, and conclusions; for Table 2 (Ref. [31–38]), Name of authors/country/year; study design, population demographics, preventive teledentistry program, and conclusions.

## 2.7 Data synthesis

A descriptive synthesis was undertaken to analyze and interpret the data extracted from the included studies. The findings were collated and summarized using a combination of narrative synthesis, tabular and visual representations. The narrative synthesis provided a detailed account of the characteristics of teledentistry interventions, their reported outcomes, and the specific contexts in which they were implemented. To enhance clarity and facilitate comparison, tabular and visual summaries, including graphs, and concept maps, were developed to illustrate accuracy of programs delivered and gaps in literature.

# 3. Results

## 3.1 Study selection

A total of 497 records were identified through database searches, including PubMed (n = 422), EMBASE (n = 13), Web of Science (n = 24), and SCOPUS (n = 38). An additional five records were located through citation searching (Fig. 1). After removing 288 duplicates using EndNote21 (Clarivate Analytics, Philadelphia, PA, USA), 209 records remained for screening. Following title and abstract screening, 159 records were excluded. Of the 50 full-text articles sought for retrieval, two could not be retrieved. Ultimately, 48 full-text articles were assessed for eligibility. Of these, 25 were excluded as they did not match the inclusion criteria (**Supplementary Table 2**). Consequently, 23 studies were included in the final synthesis of this scoping review.

## 3.2 Diagnostic application of teledentistry in pediatric caries detection

A total of 15 studies were identified focusing on the application of teledentistry for diagnosing dental caries in children across various global settings, including Iran (n = 3) [15, 21, 22], Egypt (n = 1) [23], Australia (n = 3) [11, 24, 25], Saudi Arabia (n = 2) [16, 26], South Africa (n = 1) [27], India (n = 2) [14, 28], Brazil (n = 1) [29], Germany (n = 1) [30], and the United States (n = 1) [10]. The majority of these studies adopted diagnostic accuracy or cross-sectional designs and utilized store-and-forward or mobile health (mHealth) modalities, employing intraoral photographs, smartphone-based applications, and video-based assessments (Table 1).

Seyfi demonstrated sensitivity (91.2%–91.6%) and specificity (97.2%–99.6%) of teledentistry programs in children with special healthcare needs using mobile teledentistry, with a kappa value ranging from 0.89 to 0.93 [15]. AlShaya *et al.* [26] showed that teachers using smartphones could achieve caries detection sensitivity of 98.3% for primary teeth and 88.5% for permanent teeth, with corresponding specificities of 91.4% and 96.1%. Estai *et al.* [11] supported mHealth as an acceptable tool for caries detection, while Azimi *et al.* [24] highlighted feasibility of parent-captured photos, albeit with variable sensitivity (44%–88.4%).

Two studies demonstrated that even non-dental personnel could reliably contribute to caries detection following training [28, 31]. Tools like the International Caries Detection and Assessment System (ICDAS), Caries Assessment Spectrum and Treatment (CAST), and Decayed, Missing, Filled Teeth (DMFT), were the most commonly used diagnostic benchmarks across these studies.

## 3.3 Preventive applications of teledentistry in pediatric populations

Eight studies explored the use of teledentistry platforms for preventive oral health interventions targeting parents, caregivers, and children [24, 31–37]. These interventions included parental education [33], AI-based apps for risk prediction [32], school-based models [37], and mHealth programs, such as WhatsApp-based behavioral interventions [36].

**TABLE 1. Characteristics of included studies for diagnosis of dental caries in children using teledentistry.**

| Sr No. | Authors/Year/Country | Study design | Sample population | Teledentistry modalities | Technologies used | Caries screening method | Conclusions |
|---|---|---|---|---|---|---|---|
| 1. | Ashtiani *et al.* [21] 2024, Iran | Cross sectional study | n = 131; age group = 6–12 years | Caries screening by mobile phone application | mHealth software | Intra-oral photographs | Teledentistry have been proven to be cost effective measure in diagnosis of dental caries in children from low-income countries. |
| 2. | Aly *et al.* [23] 2024, Egypt | Randomized factorial trial | n = 27; Children under 6 years | Intraoral camera and smartphone | C50 Full HD intraoral camera, Samsung Galaxy A24 smartphone | CAST (Caries Assessment Spectrum and Treatment) index | Aims to assess effectiveness of tele-detection methods and referral pathways for early childhood caries control. |
| 3. | Mohamed Estai *et al.* [11] 2021, Australia | Cross sectional | n = 138; M = 67, F = 71 age group = 4–12 years | DMFT index by mobile phone camera application | mHealth software | Intra-oral photographs | Teledentistry is acceptable in primary caries detection among the children. |
| 4. | Nasim Seyfi [15] 2024, Iran | Diagnostic accuracy study | n = 115 SHCN school children | Mobile teledentistry | Smartphone camera, Email | Visual examination (DMFT/dmft index), Photographic assessment | Teledentistry showed high sensitivity (91.2%–91.6%) and specificity (97.2%–99.6%) with almost perfect agreement (kappa: 0.89–0.93). Suitable for caries screening in SHCN children. |
| 5. | Somayyeh Azimi *et al.* [24] 2023, Australia | Diagnostic cross-sectional study | n = 42 preschool children (<4 years) and their parents | Parent-captured dental photos via mobile app | Smartphone app ("Tele-dental"), Remote-i platform | ICDAS-II (gold standard: pediatric dentist; test: OHTs reviewing photos) | Teledentistry showed high specificity (≥95.5%) but variable sensitivity (44%–88.4%). Feasible for ECC screening post-training, with 90% photo quality rated good/fair. Parent acceptance was high. |
| 6. | AlShaya *et al.* [26] 2022, Saudi Arabia | Diagnostic accuracy study (Smartphone app with real-time feedback guidelines) | n = 95 schoolchildren aged 5–10 years (54 boys, 41 girls) from a private school in Jeddah | Non-dentist (teachers) and dentist teledentistry | iPhone X smartphone camera | Clinical examination (WHO criteria) *vs.* blinded analysis of intraoral photos | Teledentistry showed high accuracy for caries detection in primary (sensitivity: 98.3%, specificity: 91.4%) and permanent teeth (sensitivity: 88.5%, specificity: 96.1%). Non-dentist personnel (teachers) achieved comparable results to dentists. |

**TABLE 1. Continued.**

| Sr No. | Authors/Year/Country | Study design | Sample population | Teledentistry modalities | Technologies used | Caries screening method | Conclusions |
|---|---|---|---|---|---|---|---|
| 7. | Golsanamloo *et al.* [22] 2022, Iran | Double-blind clinical trial | n = 20 children (6–12 years) with dental caries | Mobile phone teledentistry (photos + radiographs) | iPhone 13 smartphone camera | Clinical exam *vs.* virtual exam (photos) *vs.* gold standard (expert pedodontist) | Teledentistry showed comparable accuracy to clinical exams (sensitivity: 76.44%, specificity: 92.9%). No significant difference in treatment plans between virtual and clinical exams ($p > 0.05$). Intra examiner reliability (ICC = 0.92) was high. |
| 8. | Alkilzy *et al.* [30] 2019, Germany | Randomized controlled trial | n = 49 children (5–6 years old; test group: n = 26, control: n = 23) | Smartphone app with real-time feedback | Manual toothbrush with gravitation sensor + Bluetooth-connected app (iOS/Android) | Plaque index (QHI) and gingival index (PBI) and DMFT | The app significantly improved oral hygiene indices (QHI: 0.44 *vs.* 1.49; PBI: 0.05 *vs.* 0.21 at 12 weeks) compared to controls, demonstrating efficacy for medium-term plaque reduction. |
| 9. | Bissessur & Naidoo [27] 2019, South Africa | Concordance study (comparative analysis) | n = 233 children (6–8 years old) | Store-and-forward teledentistry | Intraoral camera (Kodak 1500-Carestream), laptop, web-based eFiles | DMFT index (Decayed, Missing, Filled Teeth) via traditional *vs.* teledentistry screening | Teledentistry showed high diagnostic agreement (kappa: 0.9630–0.9480) with traditional screening, proving reliable for caries detection in underserved areas. |
| 10. | AlShaya *et al.* [16] (2018), Saudi Arabia | Reliability study (diagnostic accuracy) | n = 57 children aged 6–12 years; 342 comparisons by 6 examiners | Store-and-forward | iPhone 7, Google Drive, WhatsApp Messenger | WHO oral health assessment form (2013); images analyzed without radiographs | Mobile phone teledentistry offers acceptable reliability for initial caries diagnosis in children, though less accurate than clinical exams. Higher reliability in primary teeth than permanent teeth. Sensitivity > specificity, indicating more false positives. |
| 11. | Park *et al.* [25] 2018, Australia | Retrospective descriptive study | n = 77 patients (2–14 years) undergoing dental treatment under general anesthesia | Store-and-forward teledentistry | DSLR camera (Canon EOS 7D, EF 100 mm lens, Macro Ring Lite MR-14EX) Cloud-based server for image storage | Gold Standard: Comprehensive Dental Examination (CDE) with visual-tactile + radiographs. | Moderate diagnostic performance (kappa = 0.62). Higher specificity (95%) than sensitivity (61.5%). Anterior teeth: Better agreement (kappa = 0.67) *vs.* posterior (kappa = 0.59). Underestimated caries (CDE dft/DFT = 7.01 *vs.* photo = 5.22). Potential for cost-effective screening in remote areas. |

**TABLE 1. Continued.**

| Sr No. | Authors/Year/Country | Study design | Sample population | Teledentistry modalities | Technologies used | Caries screening method | Conclusions |
|---|---|---|---|---|---|---|---|
| 12. | Kohara *et al.* [29] (2018), Brazil | Diagnostic accuracy study (*in vitro* and *in vivo*) | n = 20 exfoliated primary teeth (*in vitro*); 119 primary molars from 15 children aged 3–6 years (*in vivo*) | Store-and-forward | iPhone 5, Nexus 4, Panasonic DMC-G2 macro camera | International Caries Detection and Assessment System (ICDAS); images analyzed without radiographs | Smartphone images are feasible for distinguishing sound surfaces from extensive caries lesions but are inaccurate for detecting initial and moderate lesions. The performance was similar between smartphones and macro cameras. |
| 13. | Subbalekshmi *et al.* [28] (2017), India | Diagnostic accuracy study | n = 312 children aged 3–6 years | Store-and-forward | 2.5 MP intraoral camera (Dr. Schwartz Home Care, Japan) | Visual examination (dmft index) and digital photographs analyzed by two examiners (E1 and E2) | Teledentistry using intraoral images is feasible and reliable for caries screening in school settings, with high inter- and intra-examiner agreement (Cronbach's alpha = 0.983). Limitations include potential false positives due to visual-only diagnosis. |
| 14. | Purohit *et al.* [14] (2016), India | Cross-sectional | n = 139 school children aged 12 years | Store-and-forward | Sony Xperia smartphone (8 MP, 720p video) | Visual-tactile examination (DMFT index) *vs.* video-graphic assessment (recorded videos) | teledentistry is comparable to clinical exams for caries screening (sensitivity: 86%, specificity: 58%). Video-graphic assessment is viable for remote consultations, though specificity is moderate. |
| 15. | Daniel & Kumar [10] (2016), USA | Comparative diagnostic accuracy study | n = 78 children aged 4–7 years | Store-and-forward | iPhone 4S (photographs uploaded to Blackboard®) | Clinical visual examination (DFS index) *vs.* teledentistry (photographic assessment) by dentists and hygienists | Dental hygienists identified caries as accurately as dentists via teledentistry (Spearman's correlation: 0.99 for clinical *vs.* teledentistry hygienist). No significant difference between clinical dentist and teledentistry hygienist ($p > 0.10$). |

*DMFT: Decayed, Missing, Filled permanent Teeth; dmft: decayed, missing, filled primary teeth; n: sample size; mHealth: mobile health; SHCN: Special health care needs; M: male; F: female; DFS: Decayed and Filled Surfaces; WHO: World Health Organization; ICC: Intraclass Correlation Coefficient; DSLR: Digital Single-Lens Reflex; OHT: oral health technology; ECC: Early childhood caries; dft/DFT: primary/permanent Decayed and filled tooth.*

**TABLE 2. Studies on teledentistry using preventive measures for the reduction of dental caries in children.**

| Sr No. | Authors/Year/Country | Study design | Sample population | Preventive measures utilized | | | Technologies used | Conclusions |
|---|---|---|---|---|---|---|---|---|
| | | | | School based program | Parental education | Dental training | | |
| 1. | Fageeh *et al.* [35] 2024, Saudi Arabia | Randomized Controlled Trial | n = 100 participants (50 blind, 50 deaf), aged 12–18 years, from special schools in Jazan Province | Mobile health (mHealth) Telesmile app with tailored content (audio for blind, video/sign language for deaf) | N/A | N/A | Telesmile mobile app (Android/iOS), sign language videos, audio files, interactive modules | Telesmile app significantly improved oral health knowledge among blind and deaf students; audio and visual content tailored to disability was effective for education of the reduction in dental caries |
| 2. | Alana Aluditasari *et al.* [34] 2023, Indonesia | Diagnostic accuracy study | n = 37 highly educated parents of children aged 0–5 years | N/A | Mobile application ("SKOR GIGI"); CAMBRA (gold standard), Parental input via app | N/A | Android-based app, Firebase | "SKOR GIGI" showed high sensitivity (96.3%), specificity (100%), and agreement with CAMBRA ($p = 1.000$). Valid for caries risk assessment by highly educated parents. |
| 3. | Somayyeh Azimi *et al.* [38] 2023, Australia | Cross-sectional survey | n = 42 primary caregivers of preschool children | N/A | Mobile app for remote dental screening. Parent-captured dental photos, remote caries diagnosis | N/A | Smartphone app (Remote-i), RedCap questionnaire | High acceptance (PE: 4.54/5, PU: 4.65/5). PU and ATB significantly influenced BI ($p < 0.05$). Apps feasible for remote screening in caregivers. |
| 4. | Al-Jallad *et al.* [32] 2022, USA | Mixed methods (usability testing) | n = 42 parent-child dyads (10 in Step 1, 32 in Step 2) from low-income families | N/A | Smartphone camera, AI algorithm. AI analysis of parent-taken photos of children's teeth | N/A | AI-powered smartphone app (AICaries) | The AICaries app demonstrated excellent usability (SUS score: 78.4) and feasibility, with 78.5% of parent-taken photos being diagnostic. It offers a promising tool for at-home caries screening and education. |

**TABLE 2. Continued.**

| Sr No. | Authors/Year/ Country | Study design | Sample population | Preventive measures utilized | | | Technologies used | Conclusions |
|---|---|---|---|---|---|---|---|---|
| | | | | School based program | Parental education | Dental training | | |
| 5. | Ward *et al.* [37] (2022), United States | Prospective observa-tional cohort study | n = 164 preschool students (ages 3–5) at 7 rural Head Start sites. Children's Dental Services (CDS): n = 1467 students (ages 1–18) at 57 rural school sites. Demographics: Predominantly low-income, Hispanic/Latinx (MCHS) and mixed racial/ethnic backgrounds (CDS). | MCHS: Synchronous (live video) with on-site dental hygienists connected to remote dentists. CDS: Asynchronous (store-and-forward) with hygienists/dental assistants capturing images for remote dentists/advanced dental therapists | N/A | N/A | Laptops with USB intraoral cameras. - Digital x-ray sensors (CDS). - Electronic health records (Open Dental). - Mobile hotspots for low-bandwidth areas. | School-based teledentistry using mid-level providers (hygienists/therapists) and telehealth technology effectively identified caries, enabled preventive care, and improved access for rural children. Programs were cost-efficient and adaptable to age-specific needs. |
| 6. | Lotto *et al.* [36] (2020), Brazil | Single-blind random-ized controlled trial | n = 104 parent-child dyads (children aged 36–60 months) from low-income preschools in Bauru, Brazil. | N/A | Biweekly WhatsApp text messages. Based on Health Belief Model; included audio narrations. Parental eHealth literacy (eHEALS) | N/A | mHealth application | WhatsApp messages improved parental eHealth literacy and dietary habits, potentially mitigating ECC severity in low-income preschoolers. Longer-term studies needed. |
| 7. | Alqarni *et al.* [33] 2018, Saudi Arabia | Cross sectional study | n = 230 parents | N/A | Questionnaire-based knowledge assessment | N/A | iOS and Android mobile application ("Your child's smile") | Mobile applications significantly improved parents' knowledge of child dental health, with 75% favoring apps as an effective educational tool. |
| 8. | Kale *et al.* [31] 2019, India | Diagnostic accuracy study | n = 100 mothers and their children (3–5 years old) | N/A | Store-and-forward teledentistry via WhatsApp. Visual examination (WHO 1997 criteria) *vs.* mother's diagnosis via smartphone images | N/A | Motorola 3G smartphone (intraoral photographs) | Mothers demonstrated high diagnostic accuracy (sensitivity: 88.3%, specificity: 98.3%, kappa: 0.87) after dental health education, supporting smartphone-based parental screening. |

*CAMBRA: Caries Management by Risk Assessment; n: sample size; N/A: not applicable; AI: Artificial intelligence; AICaries: Artificial intelligence caries detection; USB: Universal Serial Bus; MCHS: Marshfield Clinic Health System; SUS: System Usability Scale; PE: perceived ease of use; PU: perceived usefulness; eHEALS: eHealth Literacy Scale.*

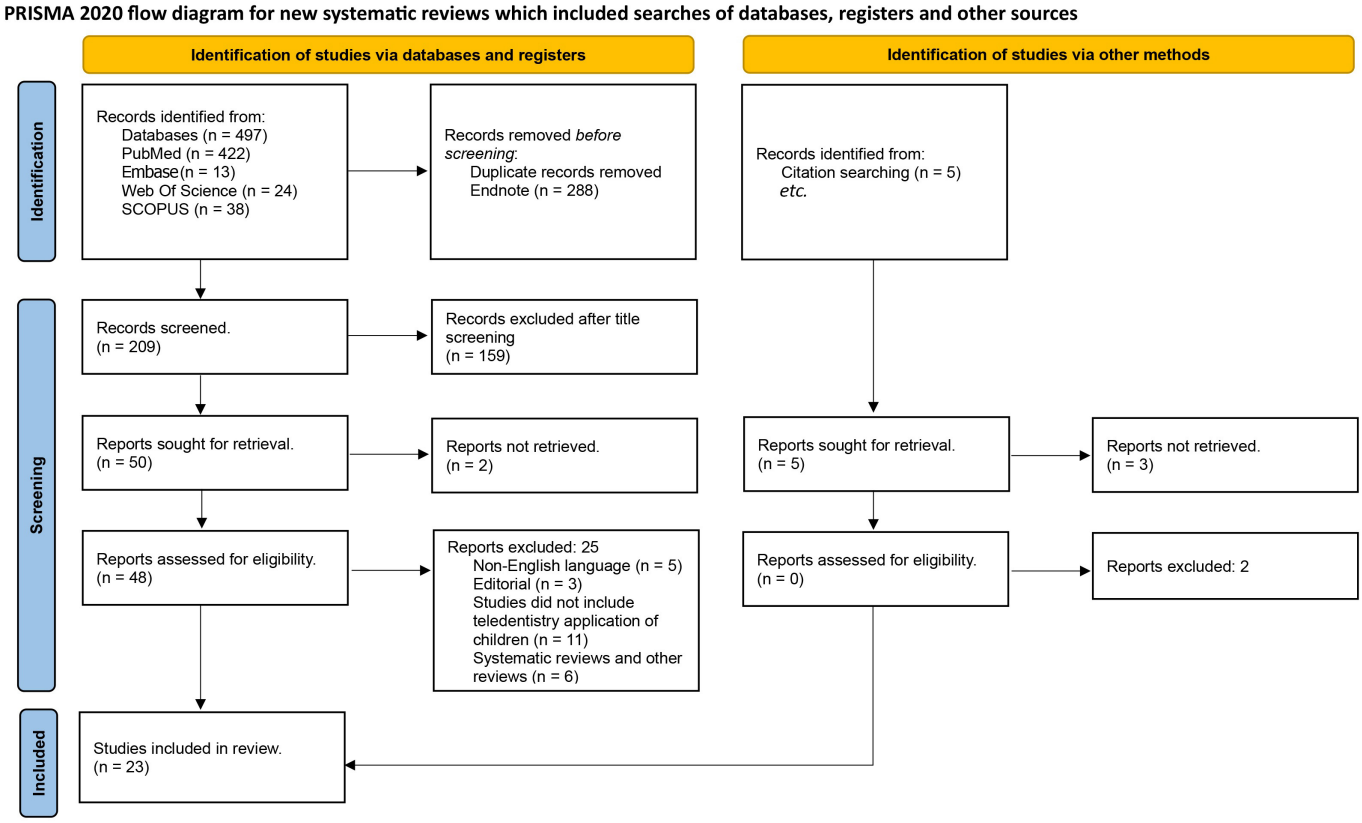



**FIGURE 1. PRISMA flowchart 2020 for study screening and selection.**

Fageeh *et al.* [35] (2024) used the Telesmile mobile app with tailored audiovisual content to improve oral health knowledge in blind and deaf adolescents, yielding significant knowledge gains. Aluditasari *et al.* [34] (2023) validated the "SKOR GIGI" app among highly educated parents, showing perfect agreement with the Caries Management by Risk Assessment (CAMBRA) gold standard for caries risk assessment (sensitivity: 96.3%, specificity: 100%) (Table 2).

School-based models were particularly effective in underserved or rural settings. Ward *et al.* [37] implemented both synchronous and asynchronous teledentistry programs using dental hygienists and mid-level providers across 64 school sites, improving access and caries detection efficiency. Similarly, Kale *et al.* [31], found that mothers using smartphones after dental education could achieve high diagnostic accuracy (kappa = 0.87), affirming the feasibility of parent-led teledentistry interventions.

### 3.4 Diagnostic accuracy of teledentistry programs

The comparison of sensitivity and specificity across various teledentistry modalities and diagnostic quality levels is illustrated in Fig. 2. The modalities assessed included mHealth, mobile teledentistry, store-and-forward systems, and teledentistry screening, with diagnostic performance. Fourteen studies reported sensitivity, specificity, and overall accuracy of teledentistry in caries detection and prevention. The highest performance metrics were noted in studies using targeted mobile applications and trained personnel.

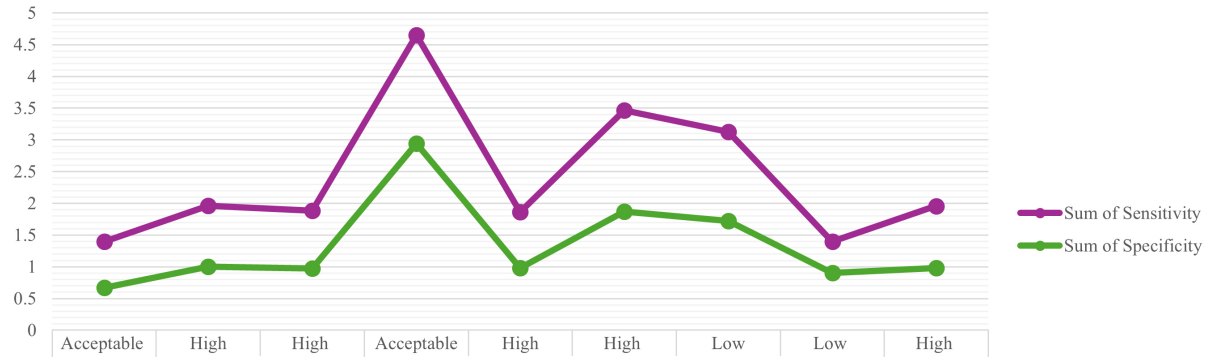
Ashtiani *et al.* [21] and Seyfi *et al.* [15] both reported high overall accuracy, with Seyfi's study showing near-perfect agreement with clinical examinations [15, 21]. On the contrary, Kohara *et al.* [29] and Park *et al.* [25] reported lower sensitivity, particularly for initial caries lesions (specificity 0.73, sensitivity 0.69), indicating underdiagnosis in earlier stages (**Supplementary Table 3**).

The integration of AI-driven applications and the use of intraoral photographs captured by caregivers or school staff helped expand access while maintaining reliability [32]. Programs combining diagnostic and educational components, such as those by Aluditasari *et al.* [34] (2023) and Kale *et al.* [31] (2019), demonstrated comprehensive success in both prevention and detection.

Overall, mobile teledentistry and store-and-forward modalities under high or acceptable quality conditions showed the most favorable diagnostic accuracy in terms of both sensitivity and specificity (Fig. 2). In contrast, mHealth and low-quality teledentistry screening demonstrated suboptimal performance, emphasizing the importance of diagnostic quality and modality selection in teledentistry-based caries detection and prevention programs in children.

## 4. Discussion

This scoping review aimed to map and synthesize the global evidence on the application of teledentistry for dental caries screening and preventive care in pediatric populations. The findings underscore the growing utility, effectiveness, and potential scalability of teledentistry as a supportive tool in pediatric oral healthcare, particularly in the domains of caries




| | Acceptable | High | High | Acceptable | High | High | Low | Low | High |
|---|---|---|---|---|---|---|---|---|---|
| | Mhealth | Mobile teledentistry | | Store and forward | | | | | Teledentistry screening |
| Sum of Sensitivity | 0.73 | 0.963 | 0.912 | 1.71 | 0.883 | 1.5944 | 1.403 | 0.5 | 0.975 |
| Sum of Specificity | 0.67 | 1 | 0.972 | 2.939 | 0.983 | 1.872 | 1.724 | 0.9 | 0.983 |

**FIGURE 2. Specificity, sensitivity, and accuracy of different caries detection programs utilized in pediatric dentistry.**

detection and prevention.

The review noted the diagnostic robustness of teledentistry in detecting carious lesions among children, with performance metrics often approaching clinical gold standards. Store-and-forward systems and mobile teledentistry emerged as the most reliable modalities, with studies demonstrating high sensitivity, specificity, and inter-rater reliability. Seyfi *et al.* [15] reported near-perfect agreement between photographic assessments and clinical exams (kappa 0.89–0.93), while Bissessur & Naidoo demonstrated kappa values above 0.94 in caries detection by photographs provided by the parents to the dentists through web-based e-files [27]. These results indicate that high-fidelity intraoral imaging, even when captured remotely, can effectively support diagnostic workflows.

Mobile health (mHealth) applications also showed promise but exhibited greater variability in diagnostic accuracy. While studies like those by Estai *et al.* [11] and AlShaya *et al.* [26] showed high sensitivity and specificity when mobile apps were used by trained individuals, Kohara *et al.* [29] noted a marked decline in accuracy when detecting early lesions. This suggests that while mHealth broadens access, its effectiveness is contingent on both image quality and user training. Notably, applications involving caregiver-captured images [38] and AI-powered interpretation [32] demonstrated that non-dental personnel could perform effective caries screening when adequately supported by technology and training.

In the current review, application of teledentistry was evaluated for different age groups and the results showed a promising outcome for different ages. For infants and preschool children (0–5 years), teledentistry is most effective for parental counseling, anticipatory guidance, caries risk assessment, and reinforcement of preventive practices, such as feeding habits and oral hygiene routines [24, 34]. In school-aged children (6–12 years), teledentistry can be leveraged for screening of caries, malocclusion, and early periodontal conditions, often through school-based programs where teachers or allied health workers assist in data collection [14, 37]. For adolescents (13–18 years), programs are particularly valuable for promoting self-care behaviors, monitoring orthodontic treatments, addressing trauma or sports-related dental issues, and supporting adherence to preventive visits [2, 22]. This stratified approach highlights that while teledentistry is applicable across the pediatric age spectrum, tailoring interventions to the developmental stage and oral health needs of each subgroup enhances its effectiveness and clinical impact.

One of the key strength of this review is the inclusion of studies from both high-income countries (HICs) and low- and middle-income countries (LMICs), offering insights into how contextual factors shape the implementation and impact of teledentistry. In HICs like Australia, the USA, and Germany, teledentistry interventions were often embedded within structured school-based or health-system-supported models, featuring high-bandwidth communication infrastructure, trained mid-level providers, and integration with electronic health records [4, 10, 36]. Programs such as the "Virtual Dental Home" in the USA or school dental tele-screening in Queensland, Australia demonstrate the feasibility and cost-effectiveness of such integrated approaches [5, 8, 23]. Conversely, in LMICs such as India, Iran, Brazil, and South Africa, teledentistry was primarily implemented through pilot studies or community-based outreach programs, often relying on mobile phones, WhatsApp, and store-and-forward imaging [14, 27, 31, 36]. While these models successfully demonstrated feasibility and community acceptance, they were often constrained by infrastructural limitations, lower digital literacy, and lack of regulatory frameworks. Nevertheless, such programs have proven critical in improving access to care in rural and underserved regions, especially where pediatric dentists are scarce.

Programs in LMICs showcased impressive creativity and adaptability. Subbalekshmi *et al.* [28] demonstrated the feasibility of school-based screening with intraoral cameras in India, while Aluditasari *et al.* [34] validated a parental risk assessment app ("SKOR GIGI") that achieved perfect agreement with CAMBRA in Indonesia. These interventions highlight the untapped potential of low-cost, community-driven models in promoting pediatric oral health.

Another key point addressed in the current review is implementation of preventive programs for caries detection with the help of teledentistry. The Telesmile app by Fageeh *et al.* [35] demonstrated significant knowledge gains among blind and deaf adolescents by offering disability-tailored content.

Similarly, the use of WhatsApp-based behavioral messaging improved parental eHealth literacy for early onset of childhood caries among low-income families [36]. Moreover, the findings of this review indicate that teledentistry can support reliable early detection of caries and periodontal conditions, improve triaging, and reduce unnecessary in-person visits, thereby optimizing clinical time. It also facilitates follow-up care, patient education, and referral pathways, especially in underserved and pediatric populations, highlighting its potential as a complementary tool within routine dental practice.

School-based teledentistry programs, by Ward *et al.* [37], successfully combined synchronous and asynchronous modalities to screen, refer, and counsel children across 64 rural school sites. These programs not only facilitated early intervention, but also served as models of interprofessional collaboration, engaging dental hygienists, assistants, and remote dentists. Moreover, in the studies by Azimi *et al.* [38] and Kale *et al.* [31], the inclusion of caregivers in the diagnostic and preventive loop promotes family-centered care and enhances long-term behavioral change. In the study by Al-Jallad *et al.* [32], AICaries app enabled caregivers to perform accurate caries screening at home, with high usability scores and diagnostic success. Teledentistry offers scalable, personalized guidance and can be tailored to support anticipatory guidance, fluoride varnish application reminders, or dietary assessments. However, teledentistry programs have several challenges, including cultural and linguistic adaptation, limited standardized content, and variability in caregiver engagement. Future research should prioritize the co-design of digital interventions with community stakeholders to ensure relevance, acceptance, and sustainability, especially in low- and middle-income countries.

Although the present review did not specifically focus on pandemic-related adaptations, it is important to acknowledge that the COVID-19 pandemic acted as a major catalyst in accelerating the uptake of teledentistry worldwide. Lockdowns and restrictions on in-person dental visits highlighted its value for preventive counseling, registration of urgent cases, and continuity of care, particularly for pediatric populations. While this review did not analyze these developments in detail, future research should examine how pandemic-driven changes have influenced the long-term sustainability, accessibility, and equity of teledentistry programs.

### 4.1 Clinical implications

- Capacity building: Train dental professionals, allied health workers, and school staff in standardized screening and referral protocols.
- Family-centered approach: Use culturally and linguistically appropriate educational materials and involve parents to increase engagement.
- System integration: Embed teledentistry within school health programs and primary care services to improve accessibility and scalability.
- Technology and security: Employ secure, user-friendly digital platforms with strong data protection measures.
- Quality assurance: Establish tele-mentoring, feedback loops, and periodic audits to maintain diagnostic reliability and sustainability.

### 4.2 Limitations

This review synthesizes global evidence on teledentistry in pediatric populations, highlights gaps in current practice and research, and provides practical guidance for the development and implementation of age- and context-specific preventive and diagnostic programs.

This scoping review, while comprehensive, is subject to several limitations. First, only studies published in English were included, potentially excluding relevant data from non-English-speaking regions, particularly in Latin America, Asia, and Africa, where teledentistry initiatives may be underreported in indexed literature. Second, the review only included studies published from January 2015 onwards to capture contemporary developments; this time restriction may have omitted earlier but relevant foundational work. Variability in diagnostic benchmarks and diverse teledentistry modalities further complicate thematic synthesis. Finally, the most included studies were pilot projects or cross-sectional in nature, lacking long-term follow-up data or cost-effectiveness evaluations, which are essential for assessing sustainable implementation.

## 5. Conclusions

This scoping review presents a comprehensive overview of how teledentistry is being utilized globally for pediatric dental caries screening and prevention. It reveals strong diagnostic performance particularly for store-and-forward and mobile models alongside growing innovation in preventive education and caregiver engagement. However, challenges related to infrastructure, training, digital equity, and long-term evaluation remain. With targeted investment, policy support, and community involvement, teledentistry holds transformative potential to improve pediatric oral health worldwide.

### AVAILABILITY OF DATA AND MATERIALS

Data will be available on request from the corresponding author.

### AUTHOR CONTRIBUTIONS

MKA—developed the initial protocol; performed the initial search and registered the protocol; has done initial search on PubMed and extracted the final articles; did the final data extraction and charting of the data; has written and drafted the manuscript for publication.

### ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

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## CONFLICT OF INTEREST

The author declares no conflict of interest.

## SUPPLEMENTARY MATERIAL

Supplementary material associated with this article can be found, in the online version, at https://oss.jocpd.com/files/article/2028733654400679936/attachment/Supplementary%20material.docx.

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