Systematic Review

Effectiveness of smartphone application in teledentistry for enhancing parental knowledge, attitude, and practice (kap) associated with children's oral health: a systematic review

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ABSTRACT

Introduction: Oral health is essential for children's mental and physical well-being. Caries is one of the most common oral diseases worldwide, especially in children. One of the contributing factors to this disease is parental engagement. Parents play a crucial role in children's oral health, especially their Knowledge, Attitude, and Practice (KAP). Teledentistry is one of the innovative ways to improve parental KAP due to technological advancements in leveraging the number of smartphones and the internet. Teledentistry could help parents/caregivers obtain education, consultation, diagnosis, and treatment planning about oral health via remote connection without going to dental offices. This engagement of parents/caregivers through teledentistry could build good oral health in children. This review aims to assess the effectiveness of smartphone applications for teledentistry in parental KAP related to children's oral health. **Methods:** This review followed PRISMA guidelines. We searched the articles in five databases (PubMed, EBSCOhost via Medline, Embase, ProQuest, and Scopus) using specific keywords and a PICO framework from January 2018 to December 2023. Two reviewers independently selected the articles based on inclusion and exclusion criteria. The selected articles were extracted and assessed for risk of bias using MMAT tool. **Results:** Of the 1529 articles initially identified, 14 met the inclusion criteria. All smartphone application reviewed were designed for parents/caregivers and integrated with teledentistry; however, only two applications incorporated with artificial intelligence. All application showed good assessment through application tests using SUS (3 articles), JN's principles (1 article), Net Promotor Score (1 article), MARS (1 article), TAM (1 articles), and sensitivity and specificity tests (2 articles). Parental/caregiver engagement was assessed through their Knowledge, Attitude, and Practice (KAP). This has impacted the children's oral health by improving both the plaque and gingival index. **Conclusion:** Smartphone applications for teledentistry effectively increase the engagement and KAP of the parents/caregivers, significantly improving the oral health status of the children.

KEYWORDS

Application, parent, children, teledentistry, oral health

INTRODUCTION

Children's oral health is crucial to their overall psychological and physical well-being. Caries is one of the most prevalent oral disorders globally, accounting for approximately 45% of cases. The global average prevalence of primary dental caries is approximately 514 million children, with the most significant cases occurring in the Southeast Asian region, estimated at around 135 million.[1] In Indonesia, the 2018 Riskesdas study revealed that the World Health Organization (WHO) reported a caries prevalence of approximately 90.2% in the 5-year age group, with over 14.6% of infants receiving

treatment. Approximately 75% of caries cases occur in untreated primary teeth.[2] Multiple variables contribute to the high frequency of dental caries, including parental engagement.[3]

Parental engagement plays a crucial role. Parents are primary role models and educators, influencing their children's oral hygiene practices and attitudes.[4] As a result, parents and caregivers must be knowledgeable about good oral health. Parental perceptions of their children's oral health are significantly associated with actual presence of disease and perceived need for dental care. The American Academy of Pediatric Dentistry (AAPD) also recommends that children be taken to the dentist when their first tooth appears; however, the opposite is often true.[5] Based on the 2018 Riskesdas data, the 5-year-old age group has the highest percentage of children who have never visited a dental professional, at approximately 97%. Additionally, daily brushing behavior in the 3-4-year-old age group remains low, with around 86.7% and 1.1% for the correct brushing time.[2] However, barriers such as lack of dental knowledge, low social economics, and limited access to dental professionals often make parents neglect their children's oral health.[6] Therefore, due to technological advancements, teledentistry has become one of the innovative solutions in this digital era.

Teledentistry is a branch of telemedicine that uses technology to promote oral health education, remote diagnosis and monitoring, and behavioral guidance without requiring direct and personal contact with patients.[7] The impacts of teledentistry have been felt by dentists and patients in various countries, including improvement in dental practice, reduced dental cost, time saving, increased knowledge, and the development of new behavior.[8,9] An increasing number of users of teledentistry was also further accelerated by the pandemic Covid 2019.[10,] Meanwhile, teledentistry continues to evolve with Society 5.0, which integrates artificial intelligence.[11,12,13] As a sustainable digital education media, teledentistry aligns with the third point of the Sustainable Development Goals (SDG) and the National Action Plan for Health Services. It can develop access to oral care and improve oral health status in the form of a smartphone application.[14,15]

The development of sophisticated smartphones has increased mobility and accessibility, supporting societal dynamics.[16,17,18] By the end of 2022, 68% of the global population were smartphones users.[19] This massive development goes hand in hand with an increase in internet access, which grew from 62.10% in 2021 to 66.48% in 2022.[20] Smartphone applications have expanded into various fields, including dentistry.[21] Approximately 313 apps focus on pediatric dentistry, while 562 address dental prevention.[22,23] Smartphone applications are increasingly utilized in oral health care, offering numerous benefits for both patients and practitioners. These apps primarily focus on oral hygiene education, brushing timers, and orthodontic care. Mobile health apps have proven effective in improving oral hygiene, particularly among children and adolescents, by reducing plaque index and gingival inflammation.[24,25,26]

The rapid growth of smartphones for teledentistry and the availability of dental applications make it essential to evaluate how these tools assist parents and caregivers in managing their children's oral health, especially in pediatric and preventive dentistry.[27] A pilot study showed significant improvements in parents' oral health knowledge and children's oral hygiene practices after using a mobile app.[28]

However, previous systematic evaluations have not yet thoroughly explore the potential of smartphone teledentistry applications to enhance parental involvement.[29] Therefore, this systematic review aims to improve the effectiveness of smartphone applications for teledentistry in engaging parents/caregivers in managing children's oral health.

METHODS

This study follows the guidelines for Systematic Reviews and Meta-Analyses (PRISMA) and has been registered in the International Prospective Register of Systematic Reviews (PROSPERO) under registration number CRD42024488747.

This review used the Population, Intervention, Comparison, Outcome, and Studies (PICOS) framework to address the question of the effectiveness of smartphone applications in teledentistry for enhancing knowledge, attitude, and practices (KAP) of parents regarding their children's oral health status. The detailed inclusion and exclusion criteria are presented in Table 1.

Table 1 Eligibility Criteria

	Inclusion	Exclusion
Dates	1 January 2018 – 31 December 2023	Review published before or after this period
Language	English	Other languages
Population	Parents or Caregivers of children using AI-based application	Children using smartphone, parents or caregiver with disability and children with systemic diseases
Intervention	AI based application about Children's Oral Health	Social media application Text messages application
Comparison	In the comparative study, the other group receives alternatives educational aids or different forms of exposure from the application	
Outcome	Qualitative Result (Analysis about application such as design, navigation, challenges when using application) Quantitative Result (clinical outcome, usability test, parent's or caregiver's KAP (knowledge, attitude, and practice))	The results are not related to oral health and the application
Study/studies	Primary Data	Review, protocol studies

This review identified primary literature through the following electronic databases: PubMed, EBSCOhost via Medline, Embase, ProQuest, and Scopus. The search used keywords combining two board categories: Intervention (artificial intelligence, teledentistry, mobile application, digital media, smartphone application, mHealth application) and Outcome (oral health, oral health education, dental health education, dental health, oral health literacy). Whenever possible, PubMed MeSH terms were employed alongside comparable terms and phrases to expand the scope of the search algorithms.[30]

All articles retrieved using the search strategy were imported into Zotero to manage duplicates. Rayyan.ai was also used in this review to assist in screening the titles and abstracts of articles. Two reviewers (A.PM and O.M) selected the studies independently. Initially, the reviewers screened articles based on their titles and abstracts, adhering to the inclusion and exclusion criteria. Subsequently, the reviewers assessed the eligibility of the full-text articles documented the reason for exclusion. Any discrepancies were resolved through discussion with the third reviewer (B.IA).

The data were categorized into two broad sections. The first category focused on the study characteristic, providing detailed information such as the research reference (author, year, country), research method, subject, application and its usage, study aim, and the type of artificial intelligence. The second category pertained to the study results, which included quantitative data (DMF-t score, plaque score, usability test, parent's or caregiver's KAP) and qualitative results (analysis about the application, parent's or caregiver's behavior and attitude).

The risk of bias assessment evaluated the potential within the studies. Two reviewers (A.PM and O.M) assessed the quality of the studies based on the research method. This reviewed used the 2018 version of the Mixed Method Appraisal Tool (MMAT), which was specifically designed to evaluate studies with diverse designs, including qualitative, quantitative randomized controlled trials, quantitative non-randomized, and mixed-methods design. Unlike other appraisal tools, the MMAT doesn't calculate the overall score but isntead encourages a more detailed assessment.[31,32]

RESULTS

This review identified 1,529 articles from five databases using specific keywords and predefined criteria. After remocing duplicates 879 articles remained. These were screened by reviewing the titles and abstracts based on the PICOS framework, resulting in 82 articles. Following a full-text eligibility assessment, 30 articles were excluded due to the wrong population, 20 articles for the wrong intervention, 4 for the wrong outcome, and 14 articles for the wrong study. Ultimately, 14 articles were included in the review (Diagram 1).

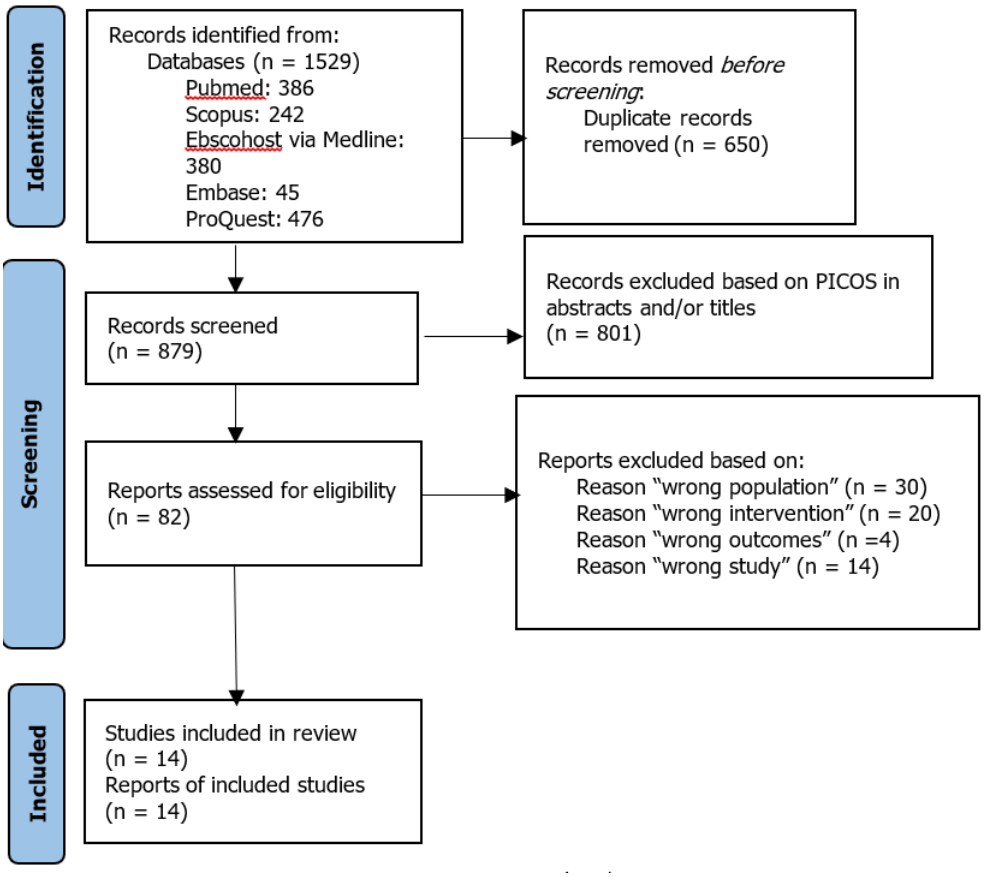

Diagram 1. PRISMA Flowchart

Eleven articles were published between 2018 and 2023, with the highest number of publications in 2022 and 2023. These studies were conducted in various countries, including the USA,[33,34,3536] Iran,[37,38] Indonesia,[39] Germany,[40] China,[41] Saudi Arabia,[42] Malaysia,[43] Thai,[44] and Australia[45]. The study method used in the reviewed articles included five randomized controlled trials,[40,39,35,37,38] three mixed methods,[33,34,36] three quasi-experimental/before-after studies,[41,42,44] and three cross-sectional studies.[45,46,43]. Both parents and the caregivers were included as participants in this study.

This systematic review focuses on smartphone applications designed to improve children's oral health through parents and caregivers. These applications serve various functions, including oral health education (n=10),[33,34,36,37,38,40,41,42,43,44] caries screening detection (n=3),[36,45,46] online consultation (n=2),[41,42] caries risk assessment (n=2),[36,39] Bluetooth-enabled powered toothbrush integration(n=1),[47] personal health centers (n=1),[41] brushing management (n=1),[41] dietary tracking (n=1),[41] online appointment scheduling (n=1),[41] adverse events reporting (n=1).[41] The types of teledentistry

discussed in this review are categorized as tele-consultation (n=10),[33,34,36,37,38,40,41,42,43,44] tele-diagnostic (n=4),[36,39,45,46] and tele-monitoring (n=3).[38,41,47]

Application evaluation methods varied across the studies. The System Usability Scale (SUS) questionnaire was used in three studies.[36,41,43] One study highlighted the agreement of beta testers based on JN's principles and The Net Promotor Score.[33] Another study used the Mobile App Rating Scale (MARS).[37] Additionally, one study reported a high score (>86%) across five categories, evaluating usage, acceptance, and parental perception of digital applications..[40] One study reported measuring uses satisfaction.[44] Another study favored the effectiveness of the application to improve children's oral health by 75 % of participants.[42] One study used the Technology Acceptance Model (TAM) for analysis.[45] Two studies assessed their application's sensitivity and specificity.[39,46] Additionally, three studies provided qualitative results about the application quality based on feedback from beta testers.[33,34,36]

Only two of the fourteen included studies incorporated artificial intelligence into their application. One AI to detect caries in children, while the other used AI-powered chatbots to improve oral health.[36,44]

Seven of the fourteen studies focused on parent's and caregiver's knowledge of oral health.[33,37,38,40,41,42,44] Among these, six reported significant improvement in knowledge.[33,37,40,41,42,44] However, one study found no significant difference in knowledge outcomes between the application and a pamphlet.[38]

Two of the included studies found no significant difference in attitude score between the application and conventional method.[38,40]Seven studies in this review explored behavior improvement among parents/caregivers after using smartphone applications.[33,34,35,38,37,40,44] Three of these studies mentioned significant behavior improvement in the application group compared to the conventional group.[37,40,44] One study found no significant difference in practice scores between the application and a pamphlet.[38] Another study recorded no engagement in oral health behavior.[33] Two studies reported mixed findings, showing some significance but lacking overall substantial results.[34,35]

Only one out of ten studies in this review reported dmft index as a measure of oral health status, finding no significant difference between the application and verbal oral health education.[40]

Three studies assessed plaque index as a marker of oral health status using various measurement methods. Two studies reported significantly better plaque index scores in the application group compared to the conventional group, using Loe & Silness and Approximal Plaque Index (API) methods .[37,40] However, another study found no significant difference in scores when using the modified plaque index (m-PI) between the application and conventional method.[38]

The gingival index was evaluated in only one study, which reported a significant improvement in the modified gingival index (m-GI) score in the application group compared to the conventional method.[38]

Table 3 Quantitative and Qualitative Result

Author, Year (Country)	Methods	Subjects	Apps	Usage	Aim of Study	Teledentistry	AI	Application Measurement	Outcome
Alqarni, A.A. et al., 2018 (Saudi Arabia)	Quasi experimental (before and after study)	230 parents	Your child's smile	Oral health education, online consultation	To evaluate the mobile app's efficacy on parents' oral health knowledge	Tele-consultation	No	-	• A significant improvement in parents' knowledge during pregnancy and their children's development was observed after using the application. ($P < 0.05$) • The majority of parents (75%) favored the use of mobile applications as an effective tool for enhancing children's dental health knowledge.
Nolen, S. L., et al., 2018 (USA)	Mixed Methods	8 parents or caregiver of 1-6 years old and have an iPhone	ToothSense	Oral health education	To evaluate the app's TPB intervention strategies in terms of quality, performance, potential for suggestion, usability, and user perceptions.	Tele-consultation	No	• JN's principles • The Net Promotor Score • Thematic analysis	• Beta testers agreed 4 of 5 JN's principles • The Net Promotor Score indicated a likelihood to recommend the app prototype • OHI and Sugar Bug Status were crowded and hard to read • Smiles Club and Mouth Journal were difficult to navigate due to the lack of pop-ups for error recovery and assignment completion • Several app buttons were confusing • Oral health information provided new information
Lozoya, C. J. S., et al., 2019 (USA)	Mixed Methods	26 parents of their first child in preschooler who used an iPhone	ToothSense	Oral health education	To investigate how a smartphone app affects preschoolers' oral health by forming parents' attitudes, subjective norms (SN), intents, and perceived behavior control (PBC).	Tele-consultation	No	• Thematic analysis	• No significant behavioral intention and attitude correlated pre- and post-intervention • Significant correlation between Subjective Norm and Perceived Behavioral Control. • Five emergent themes in oral health recommendation by brush reminder and video.
White, J. S et al., 2020 (USA)	RCT	36 parent-child dyads enrolled in an EHS home visit program for 0–3 years old	The Sonicare for Kids (S4K) app	Bluetooth-enabled powered toothbrush	To compare a waitlist (delayed incentive) with a fixed monetary incentive package and a combination lottery	Tele-monitoring	No	-	• Greater score in toothbrushing practice in lottery group than incentive and control group among children ≤ 24 months

					incentive package to evaluate their feasibility, acceptability, and short-term effectiveness in for incentivizing low-income parents of children under four.				• No significant difference toothbrushing practice among group in children ≥ 24 months • No significant difference among three groups in dental visit
Muhamat, NA. et al., 2021. (Malaysia)	Cross sectional	Ten beta testers consisting of parents of 4 to 6-year- old children attending Dental Clinic at Hospital Universiti Sains Malaysia	Gigiku Sihat	Oral health education	To assess Malaysian Gigiku Sihat usability (SKAMA).	Tele-consultation	No	SUS	• The Gigiku Sihat had a mean (SD) usability of 77.0, indicating good usability.
Zolfaghari, M., et al., 2021 (Iran)	RCT	58 mother-child pairs with children aged ≤6 years old	Simple Apps and Gamified App	Oral health education	To evaluate the effects of app gamification on mothers' oral health education for their children.	Tele-consultation	No	-	• Greater improvement knowledge in gamified app than simple app • Greater improvement practices in simple app than gamified app • Children had better Plaque control in gamifed app group (P<0.05).
Al-Jallad, N., et al., 2022 (USA)	Mixed Methods	Phase 1: 10 mother-child pairs with children aged 1-5 years old, who have insurance, and Android smartphones. Phase 2: 32 mother and child pairs	AI-Caries	Caries detection screening, caries risk assessment, oral health education	To evaluate parents' acceptance, usage, and feasibility of the AICaries app	Tele-consultation, tele-diagnostic	Yes (caries detect-ion)	• SUS • Moderated test using Think-aloud • Unmoderated field test	• AICaries app received a 78.4 SUS score, indicating an excellent acceptance. • Moderated results: no challenges navigation, 40% no challenges in caries risk assessment, 40% no challenges in taking photos of children's anterior teeth,20% no challenges in taking photos of children's posterior teeth • Unmoderated result: 78,5% high enough quality of parent-taking photos and perceived benefit including home screening, oral health information, and relatives
Pithpornchaiyakul, S. et al., 2022 (Thai)	Quasi experimental	71 caregiver- child pairs with children aged 6-36 months.	21-day FunDee and 30-Day Fun Dee	Oral health education	To assess the effectiveness (knowledge, practice, perception based on	Tele-consultation	Yes (Chatbot rule-based)	-	• Both chatbots significantly improved overall knowledge, overall oral health care perceptions based on PMT, and toothbrushing for children by caregivers.

					PTM) and usability of two chatbots.			• Study I had statistically significant differences in toothbrushing at least twice a day • Plaque levels differed significantly in study I
Shirmohammadi, M. et al, 2022 (Iran)	RCT	45 mother-child pairs with children aged 2-6 years old,	Smartphone Application	Oral health education, tooth brush reminder	To compare its efficacy to pediatric dentistry oral health education. .	Tele-consultation, tele-monitoring	No	-	• No significant difference in knowledge, practice, and m-PI score between the application and a pamphlet • A significant difference in the m-GI score was observed in the application compared to the pamphlet
Zhang, C. et al., 2022 (China)	Quasi experimental (before-after study)	20 children's caregivers	Mobile application	Personal center, oral health education, brushing management, dietary record, online consultation, online appointment, feedback of adverse events	To evaluate mobile app usability and quality	Tele-consultation, tele-monitoring	No	• SUS • MARS	• The overall value of SUS was 67.75 • The mean of overall quality, except subjective quality, was 3.44±0.95 using Mobile App Rating Scale (MARS). • Significant improvement in oral health literacy was observed after using mobile app
Abdul Haq, J., et al., 2023 (Germany)	Mixed Methods	Phase 1: 24 subjects Phase 2: 43 subjects	FU-APP	Oral health education	To evaluate the acceptance and short-term effectiveness of a digital app in teaching evidence-based dental hygiene.	Tele-consultation	No		• High score (>86%) in five categories evaluating usage, acceptance, and parental perception of digital application • Significant improvement in fluoride content knowledge in the test arm (FU-APP education), but no significant differences in the control arm (verbal education). • No significant difference in improvement between the test arm and control arm • Significant difference in tooth brushing practices between the test arm and the control arm • No differences in the dmft levels were observed

									• The API score was significantly better in the test-arm at follow-up compared to the control-arm
Aluditasari, A., et al., 2023. (Indonesia)	RCT	37 highly educated parents of children aged 0-5 years, all capable of using Android–based smartphones	Skor Gigi	Caries risk assessment	To assess the Android app "SKOR GIGI"s accuracy in assessing children 0–5's caries risk as stated by parents with advanced education.	Tele-diagnostic	No	Sensitivity and specifity test	• The SKOR GIGI application demonstrated 96.3% sensitivity, 100% specificity, 100% positive predictive value, and 90.9% negative predictive value. • No significant difference was found in caries risk assessment for children aged 0-5 years using SKOR GIGI and the Indonesian CAMBRA program.
Azimi, S., et al., 2023. (Australia)	Cross Sectional	44 parent- child pairs	Tele-Dental	Caries detection screening	To assess primary caregiver acceptance of a TAM-based telehealth application for dental screening, focusing on the early detection and referral of early childhood caries.ECC.	Tele-diagnostic	No	Sensitivity and specificity test	• Higher score in and specificity (>=95.5%) and sensitivity test (44%-88.4%.) than gold standard examination. • Parents could take good quality photos, as 90% were rated as good to fair.
Azimi, S., et al., 2023. (Australia)	Cross Sectional	42 parents/caregivers of children of aged 3-years-old	Tele-Dental	Caries detection screening	To determine the effectiveness if tele-dental screening in detecting ECC, analyzing parent photos, and collecting participant opinion on its acceptability.	Tele-diagnostic	No	TAM	• High satisfaction in all themes, high response consistency in PE, PU, ATB, and SE, moderate response consistency in ANX and BI, and favorable correlation about overall intention

All of the selected studies in this systematic review were evaluated for their quality and risk of bias using MMTA. A heatmap was used to visualize the quality assessment results, with "Yes", "No", and "Can't Tell"responses. Only one of the fourteen studies achieved five "Yes" responses, while the rest exhibited various responses of "No" and "Can't tell". Quantitative randomized controlled trials frequently lacked incomplete outcomes, blinding examiners, and adherence to participant assignment.[40,39,35,38] Meanwhile, shortage in various aspects occurred in all quantitative non-randomized studies. [45,46, 41,48, 43, 44] Additionally, all the mixed-method studies exhibited insufficient rationale and inconsistencies aspects[33,34,36] (Figure 1).

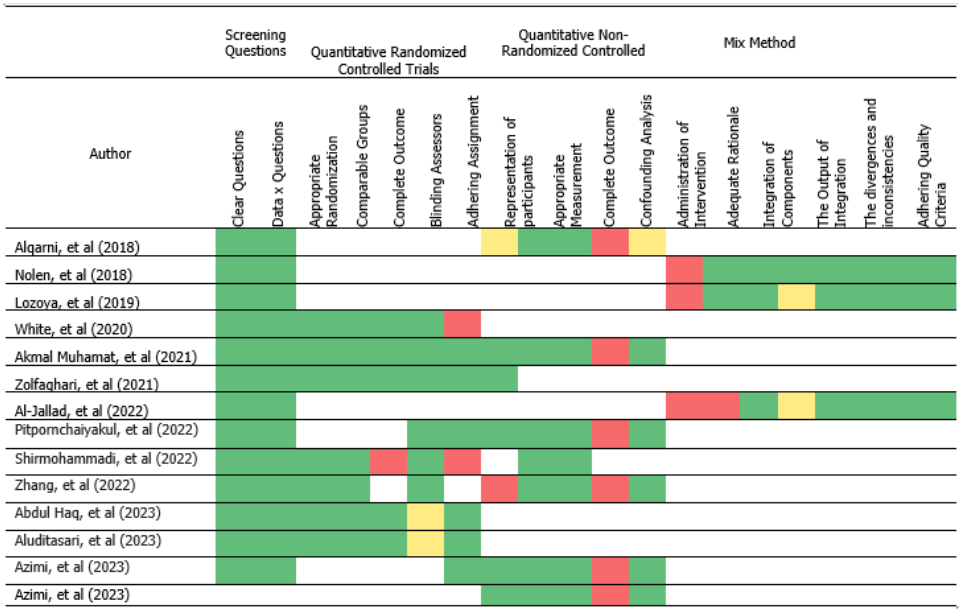

Figure 1 Risk of Bias Assessment According to MMTA

DISCUSSION

This systematic review provides evidence supporting the effectiveness of smartphone applications for teledentistry in empowering parents to take a proactive role in their children's oral health. Based on PRISMA criteria, fourteen articles published between 2018 and 2023 were included in tgis review, highlighting the emergence of new digital education and teledentistry solutions to improve their children's oral health. It indicates that the educational support for parents in promoting oral health has developed alongside technological advancement, particularly during the COVID-19 pandemic.

These technologies enable remote consultations, diagnosis, and monitoring, expanding access to dental care and overcoming geographical barriers.[27] This study demonstrated clinically and statistically significant improvement in children's oral health and parents' KAP through the integration of smartphone applications with teledentistry.[49] While some studies found no significant changes in parents' behavioral intentions based on the Theory of Planned Behavior, these applications still supported the development of oral health habits through reminders and educational videos.[34]

Apps featuring reminders, educational videos, and interactive elements like virtual pets have proven effective in promoting oral health. Smartphone applications for

teledentistry may effectively integrate oral health promotion into children's daily routines, leading to long-term positive impact.[50]

Significant improvements in parental Knowledge, Attitude, and Practice (KAP) were observed in application groups across several studies.[33,34,35,37,38,40,44] This positive impact can be attributed to the interactive nature of the application, which utilized images and video to provide comprehensive, easy-to-follow, and useful information. In addition, the application's accessibility could be reached anytime and anywhere. On the other hand, some studies did not find significant differences between the mHealth application group and the control group due to the short-term nature of the trials, which couldn't be more clearly observed.[40,38]

Most studies in this review assessed plaque index to determine the improvement in children's oral health.[40,37,38] Plaque is well known as the primary etiological factor for caries and periodontal disease, and plaque removal through toothbrushing is a key strategy for managing these conditions. Smartphone applications can effectively integrate oral health promotion into children's daily routines by incorporating engaging elements such as virtual characters, time pressure, fantasy, tutorials, and gamification.[50,51] Studies have found that apps incorporating gamification features and evidence-based dentistry recommendations can effectively motivate children to learn and maintain proper oral care habits.[52]

Other clinical assessments included the decayed, missing, filled teeth (dmf-t) index in one study and the gingival index in another.[40,38] While all studies reported significant improvements after using the application, no significant differences were found between the intervention and control groups. The difference in significance between the intervention and control groups among the studies in this review may be attributed to the short duration of the research, particularly in relation to dmf-t measurement. Maintaining oral hygiene typically requires a longer period, and the average is around 66 days.[53]

Application measurements also involved the collection and analysis data on user behavior, engagement, and performance through mobile devices. Most studies assessed usability quantitatively with the SUS questionnaire, a common questionnaire for evaluating electronic systems, especially mobile phones.[36,41,43,54] Compared to other usability questionnaires. SUS offer a more concise and efficient approach with fewer questions and shorter completion time.[54] Another usability test used in this study was JN's five principles.[33,]

The quality of the application in this review was assessed with the Mobile App Rating Scale (MARS), a widely used questionnaire for evaluating the quality, safety, and practicality of mHealth application.[37,54] Additionally, the Net Promotor Score questionnaire was used in one study to measure user satisfaction and willingness to recommend the application to others.

In terms of acceptance, the Technology Acceptance Model (TAM) questionnaire was used in one of the studies, which is the most used questionnaire to evaluate acceptance due to its simplicity.[54] Gohari, et al. found that SUS (36,5%) was the most commonly used questionnaire for assessing the usability of mHealth application, MARS (35,5%) for evaluating the quality of application, TAM (4,5%) for measuring acceptance, and Net Promotor Score (2%) for assessing satisfaction.[45,33,54]

The scope of the topic in the prior reviews was expanded in our systematic review.[55,56,57] This review discusses about smartphone applications for teledentistry and those integrated with AI. By including studies with and without comparison groups, this review provides a more comprehensive analysis. While all studies integrated them with teledentistry, the majority focused on tele-education, followed by teleconsultation and tele-detection.[58] A systematic review of 10 studies explained the increased use of teledentistry, particularly during COVID-19 pandemic. This included the significance of telemonitoring, telediagnosis, and teleconsultation for oral lesion, infection, and teletriage of oral health conditions. Additionally, the review emphasized the significance of teledentistry in pediatric dentistry and oral health care for older adults.[59] This approach is very helpful for dentist to provide comprehensive

dental care, including promotive, preventive, curative, and rehabilitative activities, especially in situations with limited contact, such as during the COVID-19 era, or in remote areas with limited access to healthcare services. However, only two studies integrated teledentistry with artificial intelligence, specifically for caries detection and chatbots interactions.[36,44]

Another systematic review also confirmed that artificial intelligence has been applied widely in dentistry and mainly concentrated the usage in digital diagnostic methods, especially pediatric and radiology.[57,54] All studies also almost dominated with asynchronous approaches, which are widely used in teledentistry and artificial intelligence because people can save time in their clinical lives.[56]

One notable strength of this study is its use of a systematic review approach to investigate the impact of smartphone applications for teledentistry on parental involvement in children's oral health, an area that has received relatively limited attention. Following the COVID-19 era, teledentistry has gained significant popularity and importance. This review provides valuable understanding of the current state of these smartphone applications that should be taken into account for following application development. However, the study has limitations, including insufficient critical evaluation of the included papers owing to resource constraints and the unavailability of complete texts for some publications.

CONCLUSION

This systematic review explored the impact of smartphone applications for teledentistry on parental KAP in children's oral health. The findings indicate significant improvement in parental KAP, leading to increased engagement in taking care of children's oral health. Post-intervention measurements in most studies showed good usability, quality, satisfaction, and acceptance of the applications. The findings of this review have implications for public health policy and clinical practice in pediatric dentistry. Smartphone applications for teledentistry have the potential to serve as scalable and accessible tools for promoting oral health and improving parental knowledge, attitudes, and practices (KAP) in children's oral health.

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