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Promoting Oral Health in Cleft Lip and Palate Patients: A Teledentistry and Social Media Messaging Intervention

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Abstract

Objectives: Children with cleft lip and/or palate (CLP) face unique oral hygiene challenges, placing them at a higher risk of dental caries and periodontal diseases. Teledentistry delivered via social media platforms can enhance oral health awareness and accessibility. This study evaluated the impact of a teledentistry-based program on toothbrushing behavior and clinical oral health outcomes among children with CLP.

Methods: A single-group pre-post intervention was conducted from October to December 2023 with 32 CLP children aged 6-14 years and their guardians. The intervention included onsite oral health education with entertainment activities, toothbrushing using plaque-disclosing tablets, and a social media group for guardians to share weekly photographs of plaque-disclosed teeth. Data collected included participation duration, plaque and gingival indices, and self-reported brushing behavior. Paired t-tests evaluated clinical changes, and correlation analysis examined relationships between participation levels and outcomes.

Results: Twenty-seven participants (84%) completed the 7-week program. Among these, 34% actively shared photos for 4-7 weeks, 28% for 1-3 weeks, and 22% did not engage. Self-reported improvements included increased brushing duration (p<0.001), better technique (p=0.003), and a more positive oral care attitude (p<0.001). Mean plaque and gingival indices significantly decreased from baseline (p<0.001). Participation level was not significantly associated with changes in clinical or behavioral outcomes.

Conclusions: A teledentistry-based program demonstrated potential to improve oral hygiene behaviors and clinical outcomes among children with CLP and to enhance dental care accessibility.

Keywords: cleft lip/palate, gingival index, oral health promotion, plaque index, teledentistry

Introduction

Children with cleft lip and/or palate (CLP) often face persistent challenges in achieving optimal oral hygiene due to both anatomical and functional limitations. Additional factors such as the higher prevalence of supernumerary teeth, dental crowding, and reduced dental arch space from maxillary underdevelopment can restrict access for toothbrush bristles and limit the natural cleansing action of the tongue and saliva, leading to plaque accumulation, gingival inflammation, and an increased risk of dental caries in this population.[1]

Maintaining good dental health is essential for successful orthodontic and craniofacial surgical outcomes in CLP patients. Premature tooth loss due to caries can result in alveolar bone loss, necessitating larger bone grafts and more complex surgical procedures, which may compromise long-term reconstructive results.[2] Although oral hygiene in CLP patients is often compromised, with appropriate preventive care their dental and periodontal health can be maintained at levels comparable to the general population.[3]

Teledentistry, a subset of telemedicine, integrates virtual technologies such as computers and mobile devices with the internet to provide digital communication for dental care, enabling remote consultations, diagnosis, treatment planning, and oral health promotion and prevention.[4,5] One of the early applications of teleconsultation was remote diagnosis and follow-up services. Programs implemented in inner-city childcare centers demonstrated that teledentistry could effectively screen preschool children for active dental caries.[6] A subsequent feasibility study found that dental screening of preschool children using intraoral cameras was comparable to visual oral examinations, supporting teledentistry as a viable screening method.[7] During the COVID-19 pandemic, teledentistry was used to manage cleft lip and/or palate patients through virtual clinics. Patients were classified using the Red-Amber-Green scale, which helped reduce unnecessary face-to-face appointments.[8] Teledentistry has also been utilized for health promotion and patient education, demonstrating its effectiveness in improving oral health outcomes. A meta-analysis evaluating the effect of teledentistry-based (telematic) strategies for oral health prevention and promotion found that these approaches may result in reductions in plaque index (standardized mean difference, -1.18; 95% CI, -1.54 to -0.82; low certainty) and gingival index (standardized mean difference, -2.17; 95% CI, -3.15 to -1.19; moderate certainty).[4]

Several studies have utilized digital interventions using social media messaging platforms to enhance oral hygiene behaviors. A mobile messaging "Brush Game" on WhatsApp encouraged adolescent orthodontic patients to share weekly selfies, resulting in significantly lower plaque and gingival indices.[9] Educational interventions delivered through Telegram channels improved toothbrushing frequency and clinical indicators among Iranian adolescents.[10] WhatsApp group messaging to parents of preschool children helped control the severity of early childhood caries and improve oral health literacy.[11]

While these studies demonstrate digital intervention effectiveness in general populations, children with CLP who face additional oral health challenges have not been explored. The present study aimed to assess the effectiveness of a teledentistry-augmented oral health program in improving oral hygiene behaviors and clinical outcomes in this population.

Materials and Methods

Study setting and subjects

The study used a single-group, pre-post design and was conducted at a host site in Chiang Rai, Thailand, between October and December 2023, within multinational care settings as part of a regional cleft care initiative led by Northern Womans Development Foundation (NWDF) in collaboration with Transforming Cleft's international network. Each implementation consisted of two 3-hour sessions: the first session provided oral health education for children with CLP, and the second session, scheduled seven weeks later by NWDF, was conducted for follow-up data collection.

The study was approved by the Human Experimentation Committee of the University of Phayao (Certificate of Ethical Clearance No. HREC-UP-HSST 1.3/067/66). Fifty-four children aged over 6 years were invited through the NWDF care network, which serves patients in Thailand, Laos, and Myanmar. Thirty-two participants aged 6-14 years attended on the day of the first session and were enrolled after confirming eligibility and obtaining consent.

Inclusion criteria were children with CLP whose guardians had internet access at home to support remote activities and who were able to attend both onsite sessions for baseline and follow-up data collection. Children with

additional physical disabilities that interfered with oral hygiene practices were excluded. There was no randomization or control group due to practical and ethical constraints, given the small multinational sample and unified program schedule.

Data collection

Data collection involved two methods: a short questionnaire developed to assess four items (Suppl. Material 1) and clinical assessment. The questionnaire provided an overview of self-reported brushing behavior, including duration, frequency, discipline, and technique using binary responses (Yes/No), and attitudes toward oral care measured on a 5-point Likert scale.

The questionnaire was intentionally kept short to fit within the 3-hour intervention schedule and to allow simple, direct translation for multilingual participants. Additional descriptions were provided to guardians to clarify assessment criteria for each item. Three experts, a general dentist, a periodontist, and a dental public health specialist, assessed the questionnaire's content validity, achieving an Item-Objective Congruence (IOC) index of 1.00 on all items.

Two Thai interviewers were trained by a dental public health specialist (P.S.) to ensure recording reliability, and interpreters for Lao and Myanmar participants were provided by NWDF to minimize language barriers during data collection.

Clinical parameters, including the Löe-Silness gingival index[12] and Silness-Löe plaque index[13], were assessed by a single board-certified periodontist (M.J.) to ensure consistency, while caries status (d_3mt/D_3MT) was evaluated by an orthodontist (K.N.), both independent from the intervention. The GI and PI were measured on six index teeth, with four sites per tooth (FDI tooth numbers: 16, 11, 24, 36, 31, 44). Examinations were conducted using a portable dental chair and artificial light for illumination.

Oral health promotion program

Limited resources were found for social media-based oral health promotion programs targeting children with CLP. Previous studies in non-cleft populations[9,10] have applied educational and preventive approaches incorporating guided oral hygiene instruction with plaque disclosure and weekly encouragement, showing improvements in plaque control and gingival health. The present oral health promotion program was designed with two components: an onsite oral health education session and a teledentistry-augmented component with weekly plaque disclosure.

The onsite session included a group activity on dental caries and proper hygiene practices, followed by supervised toothbrushing with half of a plaque-disclosing tablet (Dentiste Plaque Test Tablets, Thailand) to help children visualize plaque. Guardians were present to assist with brushing techniques and were shown how to take before-and-after photographs, focusing on an anterior view. All participants received a toothbrush, fluoride toothpaste (1,450 ppm fluoride), and plaque-disclosing tablets for use during the program.

The remote component involved the children's guardians in a weekly online activity. After the onsite session, guardians were invited to join a private group chat on a social media messaging platform (Facebook Messenger) titled "Brushing Activities." An anonymous LINE group was initially considered but was changed to Facebook Messenger based on participant preference.

This channel served as a tool within the teledentistry framework and was constructed based on Social Cognitive Theory[14], aiming to build children's self-efficacy in oral hygiene by helping them visualize plaque removal and practice skills consistently. Each weekend, guardians were instructed to help their child use a plaque-disclosing tablet at home and take close-up photographs of the child's teeth before and after brushing. These photographs served to support self-monitoring of cleaning effectiveness (Behavior Change Technique; BCT 2.3: Self-monitoring of behavior) and provided visual feedback to reinforce oral hygiene behavior (BCT 2.2: Feedback on behavior). Sharing these images within the group chat promoted engagement and a sense of peer involvement through group participation (BCT 3.1: Social support). Participation was monitored, and summary results were posted in the group every two weeks on Fridays to remind guardians to submit photos over the weekend (BCT 10.4: Social reward).[15]

At the end of the 7-week program, all participants were re-examined to assess changes in brushing behavior and clinical parameters from baseline. The intervention group chat was deleted after three months, with a small number of non-identifiable images retained for publication purposes.

Figure 1: (Left) Onsite oral health promotion session providing education and supervised toothbrushing, photographed by Northern Womans Development Foundation (NWDF) and used with permission. (Right) Facebook Messenger group chat for sharing disclosed plaque photographs weekly.

Statistical analysis

Statistical analysis was performed using SPSS version 20 (SPSS Inc., Chicago, IL, USA). The threshold for statistical significance was set at $p<0.05$. Descriptive statistics were used to summarize participant characteristics, presented as number (percentage) for categorical variables and mean (± standard deviation) for continuous variables. Participants' engagement in the remote component was categorized into three groups based on observed trends in weekly photo-sharing activity: no participation, moderate participation, and active participation.

Normality of data distribution was evaluated with the Shapiro-Wilk test, and homogeneity of variances with Levene's test. The McNemar test was applied to compare changes in categorical brushing behavior responses (pre- vs. post-intervention). Changes in clinical parameters (gingival and plaque indices) were assessed with paired t-tests. Additionally, Pearson correlation analyses were conducted to examine relationships between study variables.

Results

Participant characteristics

Baseline characteristics of the participants, including gender, age, ethnicity, caries experience, and participation level, are summarized in Table 1. The participants' ages ranged from 6 to 14 years, with the majority being of Lao ethnicity (59%), followed by Thai (33%) and Burmese (8%). Five participants did not attend the follow-up session, resulting in 27 out of the initial 32 participants (84%) completing the examination. Of these, 11 (34%) were classified as active participants (sharing photos in 4-7 of the weeks), 9 (28%) had moderate participation (1-3 weeks), and 7 (22%) did not share photos in the group chat.

Table 1: Baseline characteristics of the participants.

Characteristic	All (N=27)
Gender, n(%)	
Male	17 (63.0%)
Female	10 (37.0%)
Age (years)	
Mean (SD)	9.67 (2.69)
Range	6-14
Ethnicity, n(%)	
Lao	16 (59.2%)
Thai	9 (33.3%)
Burmese	2 (7.5%)
Participation, n(%)	
Active (4-7 weeks)	11 (40.7%)
Moderate (1-3 weeks)	9 (33.3%)
Absence (0 week)	7 (26.0%)
Caries status	
d_3mt and D_3MT (SD)	3.41 (3.88)
Absence of Caries $d_3/D_3=0$ (%)	6 (22.2%)

Brushing behavior

Table 2 presents the outcomes of toothbrushing behavior as reported by the guardians. The proportion

of children who brushed their teeth for more than two minutes increased from 14.8% at baseline to 92.6% at follow-up (p<0.001). Improvement in toothbrushing technique was also observed, with the percentage of children rated as having proper technique rising from 44.4% to 85.2% (p=0.003). Regarding brushing frequency, the proportion of participants who brushed at least twice daily increased from 85.2% to 96.3% (p=0.375). Participants also adopted better self-discipline in oral care, as indicated by an increase from 59.3% at baseline to 85.2% at follow-up in maintaining a regular brushing routine (p=0.065). Attitudes toward oral care also improved, with the average attitude scores increasing from 2.74 to 3.96 out of 5 (p<0.001).

Clinical parameters

Changes in clinical parameters, including the plaque index (PI) and gingival index (GI), are shown in Figure 2 and reported in detail in Supplementary Table 1. One participant from the moderate participation group was excluded from the analysis as an outlier due to pronounced increases in PI (+0.625, >2 SD) and GI (+0.500, >2 SD), whereas the overall group showed significant mean reductions in both indices.

Across all participants (n=26), PI decreased from 1.841±0.376 at baseline to 1.422±0.453 at follow-up (mean change -0.418, 95% CI -0.557 to -0.279, p<0.001), and mean GI decreased from 1.866±0.392 to 1.443±0.449 (mean change -0.423, 95% CI -0.572 to -0.273, p<0.001). Examining the subgroups, the active participation group (n=11) had the lowest baseline scores for both PI (1.738±0.397) and GI (1.757±0.422) and showed the greatest improvements, with PI decreasing to 1.259±0.454 (mean change -0.478, 95% CI -0.786 to -0.171, p=0.006) and GI decreasing to 1.236±0.430 (mean change -0.521, 95% CI -0.839 to -0.202, p=0.004). Participants in the moderate and no participation groups also showed significant reductions in PI and GI (within-group p<0.05).

Correlation analysis showed a strong positive correlation between PI and GI, and participation levels appeared to be associated with clinical improvements, although this association was not statistically significant.

Discussion

Teledentistry encompasses a range of approaches that integrate telecommunications and digital technologies into dental care.[4,16] Within the broader framework of eHealth, which encompasses all digitally supported health services, public health activities delivered via mobile devices are referred to as mHealth.[17] As part of this framework, teledentistry uses both computer-based systems and mobile applications to support services such as teleconsultation, telediagnosis, remote monitoring, and oral health education.[4,16,18]

Teledentistry interventions for prevention and promotion of oral health have increasingly used social media messaging platforms, with strategies adapted to distinct target populations. For early childhood caries prevention, LINE has been used to deliver structured educational content to parents and caregivers, supporting improved home-based oral hygiene in young children.[19] For patients with fixed orthodontic appliances, WhatsApp[20] and WeChat[21] have been used to support behavior change, including sending reminders and structured educational content to improve oral hygiene compliance. Among college students, WhatsApp has been used to deliver

Table 2: Changes in toothbrushing behavior and attitudes.

Characteristics	Baseline (N=27)	Follow-up (N=27)	p-value
Brushing behavior n(%)			
Duration (more than 2 minutes)	4 (14.8)	25 (92.6)	<.001*[a]
At least two times per day	23 (85.2)	26 (96.3)	.375[a]
Having self-discipline	16 (59.3)	23 (85.2)	.065[a]
Having proper technique	12 (44.4)	23 (85.2)	.003*[a]
Attitude toward oral care (SD)	2.74 (0.764)	3.96 (0.808)	<.001*[b]

*Indicates statistical significance at p<0.05

[a]McNemar test

[b]Paired t-test

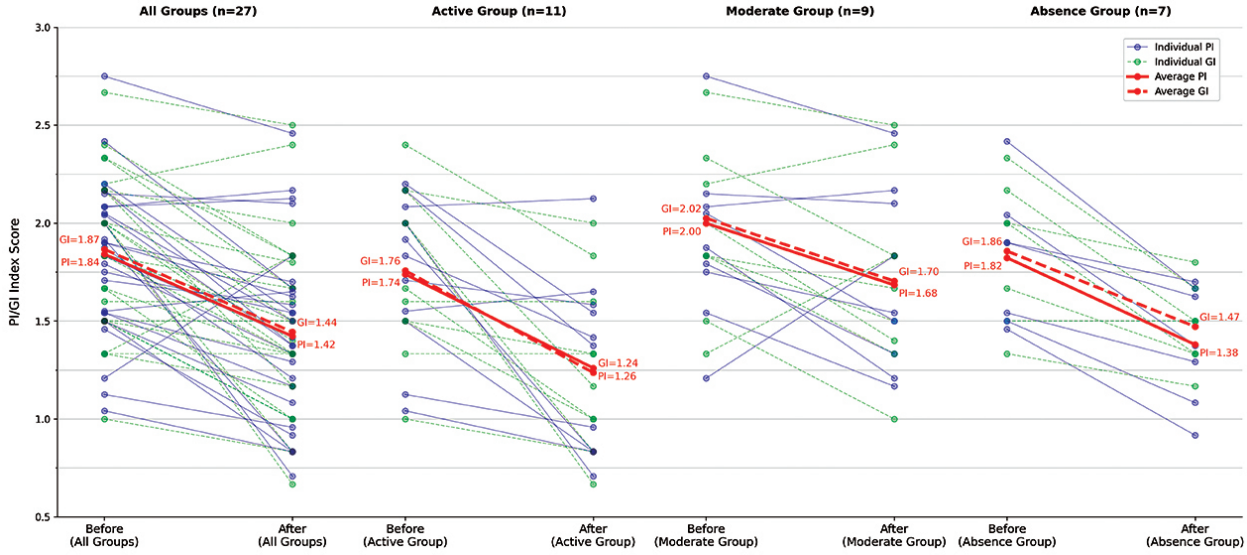

Figure 2: Changes in Plaque Index (PI) and Gingival Index (GI) scores before and after intervention. Individual PI scores are shown by blue lines, GI scores by green lines; average scores are indicated by solid (PI) and dashed (GI) red lines.

multimedia educational content aimed at enhancing oral health knowledge and daily practices.[22] The self-photograph component can be further integrated into social messaging interventions to enhance behavioral monitoring. A telegram channel has been used for weekly sharing of plaque disclosure photographs, incorporating peer interaction and competitive elements to promote engagement and adherence.[10] Similarly, a WhatsApp-based "Brush Game" required participants to submit weekly dental selfies taken before and after plaque disclosure tablet use, transforming routine plaque control into a gamified activity that encouraged consistency.[9]

Consistent with these approaches, this study utilized Facebook Messenger as a platform for guardians to photograph and share their children's plaque disclosure results weekly in children with CLP, whose oral hygiene is often compromised due to anatomical and functional limitations.[1,2] The intervention augmented a conventional oral health promotion program for children with CLP by integrating teledentistry components. The onsite component provided oral health education, oral hygiene instruction, and supervised toothbrushing demonstrations. Remote teledentistry activities incorporated self-photographs of disclosed teeth for behavioral monitoring and guardian engagement through social media messaging.

Intervention mapping is a systematic protocol for developing theory-based and evidence-based health promotion programs, intended to guide health promoters in designing structured interventions, whereas the components of such interventions can be described using the Behavior Change Techniques (BCTs) taxonomy to standardize reporting and facilitate replication of evidence-based programs.[15,23,24] Certain social messaging interventions have utilized the Health Action Process Approach (HAPA) to address both the motivational and volitional phases, as in an orthodontic care program delivered via WeChat that incorporated personalized reminders, weekly plaque-disclosing agent use, photographic self-monitoring, and targeted feedback from orthodontists.[21] A HAPA-based Telegram intervention explicitly incorporated BCTs including weekly plaque disclosure, photo uploads, peer interaction, and group encouragement to sustain engagement and support consistent oral hygiene routines.[10]

The implemented intervention incorporated four key BCTs within an SCT framework: plaque disclosure photography enabled self-monitoring and feedback on behavior (BCT 2.2, 2.3), which can improve patients' education and motivation by guiding their self-performed oral hygiene.[25] Group participation provided social support (BCT 3.1) and social recognition through participation monitoring (BCT 10.4). The program also incorporated guardian supervision through close-up photo-taking, which is known to improve children's toothbrushing skills and plaque control.[26] However, the degree of parental involvement was not assessed in this study. These BCT components aimed to strengthen self-efficacy in both parents and children by enabling them to observe

improvements and gain confidence in maintaining oral hygiene. As reported by guardians, significant increases were observed in brushing for more than 2 minutes (14.8% to 92.6%) and using proper technique (44.4% to 85.2%), with additional improvements in twice-daily brushing (85.2% to 96.3%) and self-discipline (59.3% to 85.2%), which may have lacked statistical significance due to high baseline values and a ceiling effect. Clinical parameters also showed improvements, with significant reductions in plaque and gingival indices (mean change -0.418 and -0.423, respectively).

In digital behavior change interventions, engagement can be conceptualized in two dimensions: behavioral engagement, defined as the extent of usage in terms of amount, frequency, duration, and depth of interaction, and experiential engagement, referring to the user's subjective experience of attention, interest, and affect.[27] Previous teledentistry interventions with weekly plaque disclosure photographs[9,10,21] did not quantify participation, which limits the interpretation of engagement in relation to outcomes. The present study addressed this gap by quantifying behavioral engagement as total participation weeks. Correlation analysis revealed a positive trend between the number of participation weeks and clinical improvements, but this association was not statistically significant. Although greater engagement is theoretically expected to improve outcomes, evidence for dose-response relationships in digital health interventions remains inconsistent and unable to demonstrate robustly.[28]

Participants were further categorized into three groups based on observed patterns: active participation (n=11), moderate participation (n=9), and no participation (n=7). Some individuals with no recorded participation demonstrated clinical improvements comparable to those with moderate participation. The non-participation group may have internalized their learning and continued practicing outside the digital space, or discontinued engagement because personal goals were met.[28] For instance, participants who achieved satisfactory plaque control may no longer have desired to participate in sharing self-photographs. Additionally, baseline motivation and self-efficacy, recognized as unmeasured third variables in digital interventions, may have influenced engagement patterns independently of the intervention itself, as engaged participants may have greater inclination toward healthy behaviors in general.[27] Future studies should incorporate measures of experiential engagement, motivation, and self-efficacy to better understand and adjust for these potential confounders.

The study had several limitations related to participants and research design. As part of a project organized by an external organization, the research team had limited control over participant selection and the timing of intervention and follow-up. The single-group pre-post design limits establishing causal relationships, as observed changes may not be attributed to the intervention without a control group. Instead, quantifying weekly participation served as a proxy measure for intervention exposure. The two-month assessment period was shorter than the 6-12 months reported in related studies, which may have reduced the magnitude of detectable changes and limited the ability to assess long-term effects. The small sample size (n=32, compared with n=44, 80, and 791 in previous studies[9,10,20]) also limits the generalizability of the findings. Socioeconomic variables, cultural factors, and degree of parental supervision were not collected due to the lack of standardized interpretation across nationalities and study design constraints, preventing adjustment for these potential confounding factors. Language differences require simplifying questionnaires, restricting responses to basic behavioral outcomes. Data on brushing behavior were based on guardian reports, which are susceptible to memory and social desirability bias.[10] Instead, clinical indices (PI and GI) were measured to provide an objective evaluation, as these represent the primary outcomes in teledentistry intervention studies.[4]

Despite these limitations, the teledentistry intervention combining plaque disclosure photography with guardian involvement demonstrated potential as a practical approach to improving oral health care in children with CLP. The combination of plaque disclosure and self-photography enables continuous self-monitoring of anatomically compromised areas. Regular plaque disclosure and photo sharing, coupled with remote supervision and feedback via a social media group, may reinforce proper brushing techniques and build self-efficacy for maintaining good oral hygiene practices at home. These findings suggest that integrating teledentistry into oral health programs for children with CLP is feasible across diverse care settings and may help overcome barriers to providing ongoing oral health support.

Conclusions

The teledentistry-based oral health promotion program, implemented through a social media messaging platform, demonstrated potential to improve brushing behaviors and clinical parameters among children with CLP. This approach may promote self-monitoring and enhance oral care practices, particularly in areas with limited access to dental services. Further studies with larger samples and controlled designs are needed to confirm and extend these findings.

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Conflict of Interest

The authors declare no conflict of interest.

References

1. Cheng LL, Moor SL, Ho CT. Predisposing factors to dental caries in children with cleft lip and palate: a review and strategies for early prevention. Cleft Palate Craniofac J. 2007;44(1):67-72.
2. Nahai FR, Williams JK, Burstein FD, Martin J, Thomas J. The management of cleft lip and palate: pathways for treatment and longitudinal assessment. Semin Plast Surg. 2005;19(4):275-85.
3. Lages EM, Marcos B, Pordeus IA. Oral health of individuals with cleft lip, cleft palate, or both. Cleft Palate Craniofac J. 2004;41(1):59-63.
4. Fernández CE, Maturana CA, Coloma SI, Carrasco-Labra A, Giacaman RA. Teledentistry and mHealth for promotion and prevention of oral health: a systematic review and meta-analysis. J Dent Res. 2021;100(9):914-27.
5. Estai M, Kanagasingam Y, Tennant M, Bunt S. A systematic review of the research evidence for the benefits of teledentistry. J Telemed Telecare. 2018;24(3):147-56.
6. Kopycka-Kedzierawski DT, Billings RJ. Teledentistry in inner-city child-care centres. J Telemed Telecare. 2006;12(4):176-81.
7. Kopycka-Kedzierawski DT, Billings RJ, McConnochie KM. Dental screening of preschool children using teledentistry: a feasibility study. Pediatr Dent. 2007;29(3):209-13.
8. Viswanathan A, Patel N, Vaidyanathan M, Bhujel N. Utilizing teledentistry to manage cleft lip and palate patients in an outpatient setting. Cleft Palate Craniofac J. 2022;59(5):675-9.
9. Zotti F, Dalessandri D, Salgarello S, Piancino MG, Bonetti S, Visconti L, *et al*. Usefulness of an app in improving oral hygiene compliance in adolescent orthodontic patients. Angle Orthod. 2016;86(1):101-7.
10. Scheerman JFM, Hamilton K, Sharif MO, Lindmark U, Pakpour AH. A theory-based intervention delivered by an online social media platform to promote oral health among Iranian adolescents: a cluster randomized controlled trial. Psychol Health. 2020;35(4):449-66.
11. Lotto M, Strieder AP, Aguirre PEA, Oliveira TM, Machado MAA, Rios D, *et al*. Parental-oriented educational mobile messages to aid in the control of early childhood caries in low socioeconomic children: a randomized controlled trial. J Dent. 2020;101:103456.
12. Löe H, Silness J. Periodontal disease in pregnancy. I. Prevalence and severity. Acta Odontol Scand. 1963;21:533-51.
13. Silness J, Löe H. Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition. Acta Odontol Scand. 1964;22(1):121-35.
14. Bandura A. Social cognitive theory of self-regulation. Organ Behav Hum Decis Process. 1991;50(2):248-87.
15. Michie S, Richardson M, Johnston M, Abraham C, Francis J, Hardeman W, *et al*. The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. Ann Behav Med. 2013;46(1):81-95.
16. Jampani ND, Nutalapati R, Dontula BSK, Boyapati R. Applications of teledentistry: a literature review and update. J Int Soc Prev Community Dent. 2011;1(2):37-44.
17. World Health Organization. mHealth: New horizons for health through mobile technologies. Global Observatory for eHealth Series, Volume 3. Geneva: WHO; 2011.
18. Martinez B, Reynolds L. Teledentistry's potential to provide remote dental care to vulnerable populations. J Public Health Dent. 2017;77(2):184-90.
19. Choonhawarakorn K, Kasemkhun P, Leelataweewud P. Effectiveness of a message service on child oral health practice via a social media application: a randomized controlled trial. Int J Paediatr Dent. 2025;35(9):446-55.
20. Pubalan S, Hong OZ, Teh Y, Low M. Assessing effectiveness of WhatsApp messaging in oral hygiene care for orthodontic patients: a randomized controlled trial. J Orthod. 2024;51(4):407-14.
21. Wu W, Hu L, Chen Y, Cao F, Ding S, Wu T, *et al*. Effectiveness of an online application of the HAPA theory on oral hygiene intervention in young adults with fixed orthodontic appliances: a randomized controlled trial. BMC Oral Health. 2022;22(1):192.
22. Subburaman N, Parangimalai DM, Iyer K, Sukumaran A. Effectiveness of a social media-based oral health promotion programme among 18-20-year-old college students-a comparative study. Indian J Dent Res. 2021;32(4):467-71.

23. Michie S, Johnston M, Francis J, Hardeman W, Eccles M. From theory to intervention: mapping theoretically derived behavioural determinants to behaviour change techniques. Appl Psychol. 2008;57(4):660-80.
24. Bartholomew Eldridge LK, Markham CM, Ruiter RAC, Fernández ME, Kok G, Parcel GS. Planning health promotion programs: an Intervention Mapping approach. 4th ed. San Francisco, CA: Jossey-Bass; 2016.
25. Baab DA, Weinstein P. Longitudinal evaluation of a self-inspection plaque index in periodontal recall patients. J Clin Periodontol. 1986;13(4):313-8.
26. Zacharias S, Kahabuka FK, Mbawalla HS. Effectiveness of randomized controlled field trial instructing parents to supervise children on tooth brushing skills and oral hygiene. Open Dent J. 2019;13:80-6.
27. Perski O, Blandford A, West R, Michie S. Conceptualising engagement with digital behaviour change interventions: a systematic review using principles from critical interpretive synthesis. Transl Behav Med. 2017;7(2):254-67.
28. Smith KA, Ward T, Lambe S, Ostinelli EG, Blease C, Gant T, *et al*. Engagement and attrition in digital mental health: current challenges and potential solutions. NPJ Digit Med. 2025;8(1):398. doi:10.1038/s41746-025-01778-w

SUPPLEMENTARY MATERIALS

Supplementary Material 1 – The questionnaire for assessing self-reported brushing behaviour and attitudes toward oral care (ENGLISH).

1. Self-reported brushing behaviour	
1.1 Brushing more than 2 minutes	Yes / No
1.2 Having self-discipline to brushing	
* Demonstrates an awareness of brushing time and comes to brush their teeth immediately when called.	Yes / No
1.3 Appropriate brushing technique	
* Effectively removes plaque and food debris from all areas of the mouth.	Yes / No
2. Attitudes toward oral care	
2.1 Level of attitude towards oral care	Lowest / Low / Moderate / High / Highest

*The descriptions are provided to the guardians to clarify the assessment criteria.

Supplementary Table 1: Plaque index and Gingival index at baseline and follow-up

Clinical Parameters	Subgroups	Baseline (SD)	Follow-up (SD)	Mean Change (95% CI)	*p*-value
Plaque index	All (N=26)	1.841 (0.376)	1.422 (0.453)	−0.418 (−0.557 to −0.279)	<.001*
	Active (n=11)	1.738 (0.397)	1.259 (0.454)	−0.478 (−0.786 to −0.171)	.006*
	Moderate (n=8)a	1.999 (0.363)	1.684 (0.489)	−0.314 (−0.525 to −0.103)	.010*
	Absence (n=7)	1.822 (0.348)	1.379 (0.304)	−0.442 (−0.642 to −0.243)	.002*
Gingival index	All (N=26)	1.866 (0.392)	1.443 (0.449)	−0.423 (−0.572 to −0.273)	<.001*
	Active (n=11)	1.757 (0.422)	1.236 (0.430)	−0.521 (−0.839 to −0.202)	.004*
	Moderate (n=8)*a*	2.024 (0.363)	1.704 (0.521)	−0.320 (−0.542 to −0.098)	.011*
	Absence (n=7)	1.857 (0.365)	1.471 (0.215)	−0.385 (−0.644 to −0.126)	.011*

[a]One participant was excluded from analysis as an outlier (PI change +0.625 and GI change +0.500)

*Indicates statistical significance at $p<0.05$.

Supplementary Table 2: Correlations between clinical parameters, participation levels, and toothbrushing behaviour

Variables	Clinical parameters			Activity	Toothbrushing behaviour				
	PI	GI	dmt/DMT	Participation (weeks)	Duration	Frequency	Discipline	Technique	Attitude
PI Increment									
r	1.000	.872	.379	-.046	-.233	-.244	-.041	-.272	-.227
p-value	-	<.001*	.052	.819	.242	.220	.837	.170	.254
GI Increment									
r	0.872	1.000	.364	-.151	-.218	-.245	-.050	-.181	-.274
p-value	<.001*	-	.062	.452	.274	.219	.805	.365	.167
Participation (weeks)									
r	-.046	-.151	-.095	1.000	.152	-.036	.003	.262	-.074
p-value	.819	.452	.636	-	.448	.858	.989	.188	.713

* Indicates statistical significance at $p<0.05$

r Pearson's correlation coefficient