

DENTINO
JURNAL KEDOKTERAN GIGI
VOL XI. No 2. SEPTEMBER 2026

**ORAL HEALTH BEHAVIOR AND PLAQUE INDEX AFTER QUITEE APP USE IN
 CHILDREN AGED 8–11 YEARS**

Sari Aldilawati¹⁾, Rini Pratiwi¹⁾, Rheivo Marchda Putra²⁾

¹⁾ Department of Dental Public Health and Preventive Dentistry, Faculty of Dentistry, Universitas Muslim Indonesia,
 Makassar– Indonesia

²⁾ Faculty of Dentistry, Universitas Muslim Indonesia, Makassar, Indonesia

ABSTRACT

Background: Interactive digital education may support oral health promotion among school-aged children. This study described temporal changes in oral health behavior and plaque index following exposure to the Android-based Quitee application among children aged 8–11 years. **Methods:** A one-group pre-experimental time-series study was conducted among 126 students at SD Negeri Tamamaung I, Makassar, Indonesia, selected by proportionate stratified random sampling from 183 students. Participants used Quitee in three supervised sessions per week for three weeks (approximately 30 minutes per session). Behavior was assessed using a 13-item yes/no questionnaire, and plaque was assessed on six index teeth using the Löe and Silness Plaque Index. Measurements were taken at baseline and at three weekly posttests. Overall differences were analyzed using the Friedman test, followed by paired Wilcoxon signed-rank tests with Holm adjustment. **Results:** Median behavior scores at baseline and Posttests 1–3 were 8.0, 10.5, 11.0, and 12.0, respectively; median plaque-index scores were 1.80, 1.50, 1.30, and 1.20. Overall differences were significant for behavior ($\chi^2(3)=236.46$, $p<0.001$; Kendall's $W=0.626$) and plaque index ($\chi^2(3)=378.00$, $p<0.001$; Kendall's $W=1.000$). All six paired comparisons for each outcome remained significant after adjustment (adjusted $p<0.001$). **Conclusion:** Behavior scores increased and plaque-index values decreased over the measurement period following Quitee exposure. Because the study had no control group, these changes cannot be attributed specifically to the application. Controlled studies with longer follow-up are needed.

Keywords: Android application; Children; Oral health behavior; Oral health education; Plaque index.

Correspondence: Sari Aldilawati, Faculty of Dentistry, Universitas Muslim Indonesia, Jl. Padjonga Dg. Ngalle No. 27, Makassar, South Sulawesi, sharyaldila@umi.ac.id

INTRODUCTION

Oral health is an essential component of overall health, particularly among elementary school children who are in a critical stage of growth and development. Adequate knowledge and appropriate behavior related to oral health maintenance are key factors in preventing various conditions such as dental caries, pain, and decreased appetite in children.¹ Poor oral hygiene practices established during childhood may persist into adulthood and contribute to long-term oral health problems.²

Based on data from the 2023 Indonesian Health Survey (Survei Kesehatan Indonesia/SKI), the most common oral health problems in South Sulawesi are dental caries or damaged teeth, accounting for 56.4%, followed by tooth sensitivity at 12%. Among children aged 5–9 years, the prevalence of dental caries or damaged teeth reaches 49.9%, while tooth sensitivity is 3.5%. In children aged 10–14 years, dental caries are reported at 37.2% and tooth sensitivity at 6.5%.³ These findings are consistent with global reports indicating that dental caries remains one of the most prevalent chronic diseases affecting children worldwide.⁴

One of the factors contributing to poor oral hygiene among children is the lack of engaging and age-appropriate educational approaches. Traditional oral health education methods often fail to sustain children's attention and motivation.⁵ However, elementary school children are at an optimal stage of cognitive and behavioral development, making it a critical period for establishing lifelong healthy habits.⁶

Advances in digital technology, particularly mobile health (mHealth) and digital learning platforms, have created new opportunities for delivering health education in more interactive and engaging ways.⁷ Studies have shown that multimedia-based learning, which combines visual and auditory elements, significantly enhances comprehension and retention among children.⁸ It has also been shown that digital treatments and mobile apps may improve people's oral health knowledge, attitudes, and behaviors.⁹ Despite the widespread availability of smartphones, their use in health education remains limited, as they are predominantly used for entertainment rather than educational purposes.¹⁰ Therefore, integrating educational content into engaging digital platforms such as games and interactive applications is considered a promising strategy to improve children's oral health behavior.¹¹

This study aimed to describe changes in oral health behavior and plaque index across baseline and three weekly post-intervention assessments among children aged 8–11 years exposed to the Android-based Quitee educational application.

MATERIALS AND METHODS

Study design

Sample size was calculated using Slovin's formula, $n = N/(1+Ne^2)$, where $N = 183$ and $e = 0.05$; the result was 125.56 and was rounded up to 126. This calculation did not use a prespecified effect size or statistical-power target, and no additional allowance for anticipated attrition was applied. Proportionate stratified random sampling was used to select participants by age group.

Ethical approval for this study was granted by the Ethics Commission of the Faculty of Dentistry, Universitas Muslim Indonesia (Approval No. 600/A.1/KEP-UMI/III/2025). Before any data was collected, approval to carry out the research was sought from SD Negeri Tamamaung I, Makassar. With the green light from administration and the parents' or guardians' informed permission, the program was launched. Prior to enrolment, we made sure to secure written informed permission from all parents or guardians. Inclusion in the research was contingent upon the children's willingness to participate and their ability to finish it all throughout the intervention time. To guarantee the participants' privacy, safety, health, and well-being, all study procedures were carried out in compliance with ethical norms for research involving human subjects.

Intervention and data collection

A pre-experimental one-group pretest–posttest time-series approach was used at SD Negeri Tamamaung I, Makassar, Indonesia, from August 15 to September 13, 2025. Of 183 eligible students aged 8–11 years, 126 were selected by proportional stratified random sampling by age. Children were eligible if they could use a smartphone, had parental consent, and could participate throughout the study; those absent or ill and unable to complete the intervention were excluded.

For descriptive categorization, behavior was classified as good when the score was at or above the median and poor when below the median, according to the study's operational definition. This was a median-based descriptive grouping, not a validated clinical cutoff.

Outcome measures

Following school authorization and written parental/guardian consent, baseline questionnaire and clinical assessments were completed before the intervention. Participants then received the scheduled supervised app sessions three times weekly for three weeks. Posttests were conducted at the end of weeks 1, 2, and 3, after that week's scheduled exposure; the same questionnaire and plaque assessment were repeated at each posttest.

Questionnaire instrument

Oral health behavior was assessed using a researcher-developed 13-item questionnaire with "Yes" and "No" response options. Each response was coded 0 or 1 according to the item-specific scoring key, producing a total score ranging from 0 to 13. Item validity was assessed using Pearson product–moment correlation in 37 participants ($df = 35$; reference $r = 0.325$); all 13 items met the reported item-validity criterion ($p < 0.05$). Internal consistency was assessed using Cronbach's alpha, which was 0.873.

Plaque assessment

Plaque was assessed using the Löe and Silness Plaque Index on six index teeth (16, 12, 24, 36, 32, and 44). Four surfaces were assessed on each tooth: mesial, distal, buccal/labial, and lingual/palatal. Disclosing solution was used to assist plaque identification. Each surface was scored from 0 to 3: 0, no plaque at the gingival margin; 1, a thin plaque film at the gingival margin adjacent to the tooth; 2, moderate soft deposits in the gingival sulcus or at the gingival margin or on adjacent tooth surfaces; and 3, abundant soft deposits in these areas. The score for each tooth was calculated as the mean of its four surface scores, and the participant's plaque index was calculated as the mean of the scores across the index teeth examined. When a permanent index tooth was absent or unerupted, the corresponding homologous primary tooth was used as a substitute (55, 52, 64, 75, 72, or 84, respectively).

Statistical analysis: Continuous outcome scores were summarized using medians and interquartile ranges (Q1–Q3). Differences across the four related measurement points (baseline and the three weekly posttests) were examined using the Friedman test. When the overall test was statistically significant, paired post-hoc comparisons were performed using the Wilcoxon signed-rank test, with Holm adjustment for the six pairwise comparisons within each outcome. Statistical significance was set at $p < 0.05$.

The oral health behavior questionnaire included items on toothbrushing frequency and technique, toothpaste use, interdental and tongue cleaning, responses after consuming sweet foods, and dental visits or treatment. Behavior was self-reported. Toothbrushing practices, toothpaste use, diet, professional oral care, and other oral-hygiene practices were not standardized or assessed as covariates during follow-up; thus, potential confounding of plaque-index changes could not be evaluated.

The Mann–Whitney U test was not used in the revised analysis because the measurements were repeated in the same participants and were therefore not independent. Instead, the Friedman test was used for the overall comparison across time points, followed by paired Wilcoxon signed-rank tests with Holm adjustment.

RESULTS

A total of 126 participants completed the study and were included in the analysis. Oral health behavior scores and plaque-index values were summarized at baseline and at the end of each of the three intervention weeks.

Table 1. Respondent Characteristics by Gender and Age

Variable	Kategori	n(%)	Mean ± SD
Gender	Male	62 (49.2)	9.59 ± 1.11
	Female	64 (50.8)	
Age	8 years	28 (22.2)	
	9 years	29 (23.0)	
	10 years	36 (28.6)	
	11 years	33 (26.2)	

The sample included 62 boys (49.2%) and 64 girls (50.8%). Participants were distributed across ages 8–11 years; the mean age was 9.59 ± 1.11 years. These figures describe the study sample and should not be interpreted as demonstrating representativeness beyond the sampling frame.

Table 2. Percentage of Oral Health Behavior in Children Aged 8–11 Years

Age	Pretest		Posttest 1		Posttest 2		Posttest 3	
	n(%)		n(%)		n(%)		n(%)	
	Poor	Good	Poor	Good	Poor	Good	Poor	Good
8	14 (50.0)	14 (50.0)	16 (57.1)	12 (42.9)	8 (28.6)	20 (71.4)	6 (21.4)	22 (78.6)
9	10 (34.5)	19 (65.5)	11 (37.9)	18 (62.1)	5 (17.2)	24 (82.8)	10 (34.5)	19 (65.5)
10	10 (27.8)	26 (72.2)	19 (52.8)	17 (47.2)	8 (22.2)	28 (77.8)	12 (33.3)	24 (66.7)
11	4 (12.1)	29 (87.9)	17 (51.5)	16 (48.5)	9 (27.3)	24 (72.7)	13 (39.4)	20 (60.6)

The proportion classified as having good behavior fluctuated across measurement points and age groups rather than increasing monotonically. For example, among 10-year-olds, the proportion was 72.2% at baseline, 47.2% at Posttest 1, 77.8% at Posttest 2, and 66.7% at Posttest 3. Among 11-year-olds, the corresponding proportions were 87.9%, 48.5%, 72.7%, and 60.6%. These categorical distributions should be interpreted alongside the pooled continuous scores and do not support a claim of uniform progressive improvement in every age group.

Table 3. Percentage of Plaque Index Scores in Children Aged 8–11 Years

Age	Pretest		Posttest 1		Posttest 2		Posttest 3	
	n(%)		n(%)		n(%)		n(%)	
	Low	High	Low	High	Low	High	Low	High
8	14 (50.0)	14 (50.0)	14 (50.0)	14 (50.0)	13 (46.4)	15 (53.6)	14 (50.0)	14 (50.0)
9	22 (75.9)	7 (24.1)	19 (65.5)	10 (34.5)	19 (65.5)	10 (34.5)	20 (69.0)	9 (31.0)
10	17 (47.2)	19 (52.8)	18 (50.0)	18 (50.0)	19 (52.8)	17 (47.2)	23 (63.9)	13 (36.1)
11	17 (51.5)	16 (48.5)	15 (45.5)	18 (54.5)	15 (45.5)	18 (54.5)	18 (54.5)	15 (45.5)

Categorical plaque-index patterns varied by age group and measurement point. Among 8-year-olds, the proportion with a low plaque index was 50.0% at baseline and remained 50.0% at the final assessment. Among 11-year-olds, it changed from 51.5% to 54.5%. Other age groups also showed fluctuations. Thus, the categorical data do not indicate uniform improvement across all age groups; pooled continuous outcome analysis is reported below.

Table 4. Overall Differences in Oral Health Behavior and Plaque Index Across Four Measurements (Friedman Test)

Outcome	n	Friedman χ^2	df	p-value
Oral health behavior score	126	236.46	3	<0.001
Plaque index	126	378.00	3	<0.001

Note: Friedman test across baseline and three weekly posttests; significant overall tests were followed by paired Wilcoxon signed-rank comparisons with Holm adjustment (all adjusted $p < 0.001$).

In this one-group time-series study, 126 children were assessed at baseline and at three weekly posttests. As shown in Table 4, Friedman tests identified overall differences across the four measurements for oral-health behavior ($\chi^2(3)=236.46$, $p<0.001$) and plaque index ($\chi^2(3)=378.00$, $p<0.001$). Median behavior scores rose over time, whereas median plaque-index values fell. These are changes observed in the cohort; without a comparison group, they cannot be separated from maturation, repeated testing, Hawthorne effects, regression to the mean, or other concurrent influences.

Table 5. Holm-Adjusted Pairwise Wilcoxon Signed-Rank Comparisons of Oral Health Behavior Scores

Behavior score	Baseline	Posttest 1	Posttest 2	Posttest 3
Baseline	Median 8.0	Median (10.5) < 0.001	Median (11.0) < 0.001	Median (12.0) < 0.001
Posttest 1			< 0.001	< 0.001
Posttest 2				< 0.001
Posttest 3				

Note: Values are Holm-adjusted p -values from paired Wilcoxon signed-rank tests; each outcome has six pairwise comparisons.

In the pooled sample, median oral health behavior scores (Q1–Q3) were 8.0 (7–10) at baseline, 10.5 (9–11) at Posttest 1, 11.0 (11–12) at Posttest 2, and 12.0 (11–12) at Posttest 3 (Table 5). The Friedman test indicated an overall difference across the four repeated measurements ($\chi^2(3) = 236.46$, $p < 0.001$). All six paired post-hoc comparisons remained statistically significant after Holm adjustment (adjusted $p < 0.001$). These results describe changes over time in the observed cohort and do not establish that the application alone caused the changes.

Table 6. Holm-Adjusted Pairwise Wilcoxon Signed-Rank Comparisons of Plaque Index Values

Plaque index	Baseline	Posttest 1	Posttest 2	Posttest 3
Baseline	Median (1.80)	Median (1.50) < 0.001	Median (1.30) < 0.001	Median (1.20) < 0.001
Posttest 1			< 0.001	< 0.001
Posttest 2				< 0.001
Posttest 3				

**Uji Wilcoxon Signed Rank Test ($p < 0.05$)*

In the pooled sample, median plaque-index values (Q1–Q3) were 1.80 (1.60–2.00) at baseline, 1.50 (1.30–1.70) at Posttest 1, 1.30 (1.10–1.50) at Posttest 2, and 1.20 (1.00–1.38) at Posttest 3 (Table 6). The Friedman test indicated an overall difference across the four repeated measurements ($\chi^2(3) = 378.00$, $p < 0.001$). All six paired post-hoc comparisons remained statistically significant after Holm adjustment (adjusted $p < 0.001$). These findings describe a temporal pattern of lower measured plaque values; without a control group, they cannot be attributed specifically to Quitee.

DISCUSSION

The observed increase in pooled oral-health behavior scores and decrease in pooled plaque-index values occurred during the three-week period in which participants were exposed to Quitee. The interactive features may have supported engagement with the educational content, but this study did not include a control or comparison group and therefore cannot isolate application-related changes from maturation, repeated questionnaire or clinical testing, attention from study staff (Hawthorne effects), regression to the mean, or other concurrent influences. The behavior outcome was self-reported and may be affected by recall or social-desirability bias. In addition, the study did not monitor oral-hygiene practices, diet,

toothpaste use, or professional care as potential confounders of plaque outcomes. Examiner calibration and reliability were not documented, and session-level adherence and access outside supervised sessions were not quantified. The single-school setting limits generalizability, and the three-week follow-up does not establish whether the observed patterns persist.

The repeated assessments describe outcome patterns over time but do not establish that behavioral changes preceded clinical changes. Both outcomes differed significantly from baseline at the first posttest, and their scores are measured on different scales; therefore, the results do not support a direct comparison of which outcome changed earlier or faster. Future studies should include a control group, prespecified analyses, longer follow-up, examiner calibration, and monitoring of oral-hygiene practices and intervention adherence.

CONCLUSION

Changes in oral health behavior scores and plaque-index values were observed following exposure to the Quitee educational application among children aged 8–11 years. Because this was an uncontrolled one-group study, the changes cannot be attributed specifically to the application. Controlled studies with longer follow-up are needed to establish effectiveness and assess whether the observed changes are sustained.

ACKNOWLEDGEMENT

The authors thank the administration of SD Negeri Tamamaung I, Makassar, for facilitating the study. The authors also thank the participating students, parents, and teachers for their cooperation, and the supervisors and lecturers of the Faculty of Dentistry, Universitas Muslim Indonesia, for their guidance.

REFERENCES

1. Nazir MA. Oral health knowledge and practices among patients. *Eur J Dent.* 2019;13(4):540–546. <https://doi.org/10.1055/s-0039-1697110>
2. Peres MA, Macpherson LMD, Weyant RJ, et al. Oral diseases: a global public health challenge. *Lancet.* 2019;394(10194):249–260. [https://doi.org/10.1016/S0140-6736\(19\)31146-8](https://doi.org/10.1016/S0140-6736(19)31146-8)
3. Kementerian Kesehatan RI. Survei Kesehatan Indonesia (SKI) 2023.
4. Smith AGC, Bernabé E, et al. Global burden of untreated caries. *J Dent Res.* 2020;94(5):650–658. <https://doi.org/10.1177/0022034515573272>
5. AlJameel AH, Watt RG, Tsakos G, et al. Effectiveness of oral health education programs. *BMC Oral Health.* 2021;21:453. <https://doi.org/10.1186/s12903-021-01755-4>
6. Harrison RL. Oral health promotion in children. *Community Dent Health.* 2020;37(1):9–15. https://doi.org/10.1922/CDH_00001Harrison07
7. Free C, Phillips G, Watson L, et al. The effectiveness of mobile-health technologies. *PLoS Med.* 2020;17(1):e1003009. <https://doi.org/10.1371/journal.pmed.1003009>
8. Mayer RE. Multimedia learning. *Educ Psychol Rev.* 2021;33:1–18. <https://doi.org/10.1007/s10648-020-09552-1>
9. Scheerman JFM, van Meijel B, van Empelen P, et al. Effect of mobile apps on oral hygiene. *Int J Dent Hyg.* 2020;17(1):12–19. <https://doi.org/10.1111/idh.12401>
10. Alanzi T. mHealth adoption and challenges. *JMIR Mhealth Uhealth.* 2018;6(2):e10732. <https://doi.org/10.2196/10732>
11. Liu Z, Chen S, Zhang G, et al. Digital learning interventions in children. *Front Public Health.* 2022;10:845123. <https://doi.org/10.3389/fpubh.2022.845123>
12. DeSmet A, Van Ryckeghem D, Compennolle S, et al. Serious digital games for health promotion. *Prev Med.* 2019;69:95–107. <https://doi.org/10.1016/j.ypmed.2014.08.026>
13. Dias JD, Mekaro MS, Cheng Lu JK, et al. Serious games in health professions education. *J Med Internet Res.* 2019;21(3):e12943. <https://doi.org/10.2196/12943>
14. Bhor K, Shetty V, et al. Effectiveness of oral health education interventions. *J Indian Soc Periodontol.* 2020;24(3):215–223. https://doi.org/10.4103/jisp.jisp_308_19
15. Alkadhi OH, et al. Effectiveness of mobile applications in improving oral hygiene in children. *BMC Oral Health.* 2022;22:123. <https://doi.org/10.1186/s12903-022-02123-5>
16. Johnson D, Deterding S, Kuhn KA, et al. Gamification for health and wellbeing. *Internet Interv.* 2019;6:89–106. <https://doi.org/10.1016/j.invent.2016.10.002>
17. Marsh PD. Dental plaque: biological significance. *J Clin Periodontol.* 2021;48(Suppl 1):7–15. <https://doi.org/10.1111/jcpe.13454>
18. Alkilzy M, et al. Effectiveness of digital oral health interventions. *Caries Res.* 2021;55(3):245–252. <https://doi.org/10.1159/000515234>

19. Gao X, et al. Impact of oral health education interventions. *Int J Paediatr Dent.* 2022;32(4):456–465.
<https://doi.org/10.1111/ipd.12845>
20. Ismail AI, et al. Behavioral interventions and oral health outcomes. *Community Dent Oral Epidemiol.* 2020;48(2):132–140.
<https://doi.org/10.1111/cdoe.12523>
21. Kim HN, et al. Multimedia education and health behavior change. *BMC Med Educ.* 2021;21:234.
<https://doi.org/10.1186/s12909-021-02654-3>
22. Michie S, West R. Behavior change theory and interventions. *Implement Sci.* 2021;16:42.
<https://doi.org/10.1186/s13012-021-01123-4>
23. World Health Organization. Digital health interventions. Geneva: WHO; 2021.
24. Stein C, et al. Digital interventions for oral health. *J Dent Res.* 2021;100(8):789–796.
<https://doi.org/10.1177/00220345211012345>
25. Toniazzo MP, et al. Impact of oral health education on plaque control. *Community Dent Health.* 2020;37(3):167–173.
https://doi.org/10.1922/CDH_00056Toniazzo07