Exploring mobile applications for oral health promotion: a randomized clinical trial

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PRACTICAL IMPLICATIONS OF THIS RESEARCH

- An app can be a valuable and appealing means of complementing professional oral care and motivating some patients to practise oral self-care, improving the population's health indicators.
- Apps that monitor toothbrushing and demonstrate a step-by-step technique may have better results in improving oral health indicators.
- Oral health professionals can use these technologies to promote their patients' oral health and facilitate communication.

ABSTRACT

Background: This study explored young adults' perceptions of oral health apps and assessed whether the *Dentalcluj Brush Assistant* or *Brush DJ* app improved oral hygiene and gingival inflammation. **Materials and Methods:** An exploratory randomized clinical trial with a parallel repeated measures design was conducted among Bachelor of Dental Laboratory Technology students. Inclusion criteria required students to be between the ages of 18 and 20 years, have a smartphone, and provide informed consent. Participants received a dental hygiene appointment at baseline, followed by simple random and sequential allocation into 1 of 3 groups: *Brush DJ* app, *Dentalcluj Brush Assistant* app or control group. App users were instructed to download and use the app during the study. Questionnaires assessed oral hygiene behaviours and app perceptions at baseline and after the study. A calibrated and blinded investigator measured bleeding on probing (BOP) and the simplified oral hygiene index (OHI-S) at 3 moments, 15 days apart. Statistical analyses included Kruskall-Wallis, Mann-Whitney, Wilcoxon, and Friedman tests ($\alpha = 0.05$). **Results:** The sample comprised 24 participants (8 per group). All groups had an improved OHI-S, but the *Dentalcluj Brush Assistant* group showed the most significant results ($p = 0.004$) and was the only group with significant BOP index improvement ($p = 0.02$). Half the participants found the apps helpful, highlighting the visual step-by-step brushing technique. However, some noted issues with impracticality and aesthetics. **Conclusions:** Apps appear beneficial as a complement to oral health care appointments, with the *Dentalcluj Brush Assistant* showing the best results.

RÉSUMÉ

Contexte : Cette étude a examiné les perceptions des jeunes adultes à l'égard des applications de santé buccodentaire et a évalué si l'application *Dentalcluj Brush Assistant* ou *Brush DJ* améliorait l'hygiène buccale et réduisait l'inflammation gingivale. **Matériel et méthodes :** Un essai clinique exploratoire randomisé comprenant des mesures répétées parallèles a été mené auprès d'étudiants au baccalauréat en technologie de laboratoire dentaire. Les critères d'inclusion exigeaient que les étudiants soient âgés de 18 à 20 ans, qu'ils possèdent un téléphone intelligent et qu'ils donnent leur consentement éclairé. Les participants ont reçu un rendez-vous d'hygiène dentaire au départ, suivi d'une répartition aléatoire simple et séquentielle à l'un de trois groupes : application *Brush DJ*, application *Dentalcluj Brush Assistant* ou groupe de contrôle. On a demandé aux utilisateurs d'applications de télécharger et d'utiliser l'application appropriée. Les questionnaires ont évalué les comportements en matière d'hygiène buccale et les perceptions à l'égard des applications au départ et après l'étude. Un enquêteur étalonné et aveuglé a mesuré le saignement au sondage (BOP) et l'indice simplifié d'hygiène buccale (OHI-S) à 3 moments, à 15 jours d'intervalle. Les analyses statistiques comprenaient les tests de Kruskall-Wallis, Mann-Whitney, Wilcoxon et Friedman ($\alpha = 0{,}05$). **Résultats :** L'échantillon comprenait 24 participants (8 par groupe). Tous les groupes ont affiché une amélioration de l'indice OHI-S, toutefois le groupe *Dentalcluj Brush Assistant* a affiché les résultats les plus significatifs ($p = 0{,}004$) et était le seul groupe affichant une amélioration significative de l'indice BOP ($p = 0{,}02$). La moitié des participants ont jugé les applications utiles, mentionnant en particulier la technique de brossage visuelle étape par étape. Toutefois, certains ont relevé des problèmes de fonctionnalité et d'esthétique. **Conclusions :** Les applications semblent bénéfiques en complément des rendez-vous de santé buccodentaire, *Dentalcluj Brush Assistant* affichant les meilleurs résultats.

Keywords: mobile health; oral health; oral hygiene; toothbrushing; young adults
CDHA Research Agenda category: access to dental hygiene care and unmet needs

INTRODUCTION

Oral diseases continue to be a worldwide public health challenge, imposing a considerable social and economic burden on individuals and populations due to their high prevalence.[1,2] Despite their prevalence, dental caries and periodontal disease can be prevented by controlling oral biofilm,[3,4] with twice-daily toothbrushing[5,6] with fluoridated toothpaste being widely recommended.[6,7]

Oral biofilm control requires a daily self-care routine, which can be difficult to adhere to and maintain over time.[1] One of the primary roles of the dental hygienist is to motivate

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and provide the necessary instructions for correct biofilm removal, and it is essential to reinforce this regularly. Since there is still a low frequency of regular visits to oral health professionals in the Portuguese population,[8] technology could complement the oral care appointment, reminding the patient of the instructions given and motivating them to practise oral self-care more regularly and over time.

The last few decades have seen an intense technological revolution, with technology increasingly influencing people's routines, especially in young adults.[9] Accompanying this technological growth has been the use of technology and mobile applications (apps) in the health sector to improve and maintain health care, an approach referred to as Mobile Health or MHealth.[10,11] The World Health Organization (WHO) defines MHealth as a medical and public health practice supported by mobile devices such as cell phones, patient monitoring devices, personal digital assistants, and other wireless devices.[11] The use of apps is an innovative way of improving health care. It can promote closer and faster communication with the health care professional and allows individuals to quickly monitor their health through access to helpful information anytime and anywhere.[12]

There has also been a growing use of technology to promote oral health, with several apps that aim to help the routines of patients and oral health professionals.[13] Most of these apps are designed to improve toothbrushing, using reminders for twice-daily toothbrushing and instructions on the technique to adopt.[8,14] Some contain information on complementary oral hygiene aids (such as floss and fluoride)[9,14] or information about oral health appointment frequency.[14] There are also gamified oral health apps[15-17] and apps from specific brands linked via Bluetooth to electric toothbrushes, which allow more accurate and monitored toothbrushing.[14]

The use of apps in oral health is increasing among patients, especially younger ones, and it has the potential to improve oral hygiene, knowledge, and behaviours, but more studies are needed.[18,19] Some studies have revealed that the use of digital devices, which provide reminders and toothbrushing instructions visualized in real time, can be effective in controlling biofilm and, consequently, in controlling gingival inflammation.[19-30]

In the Portuguese population, studies are needed to evaluate this type of app's use, effectiveness, and acceptability. Therefore, the present study aimed to analyze if an app can motivate young Portuguese adults to practise oral health self-care using 2 existing apps (*Brush DJ* and *DentalCluj Brush Assistant*). The specific objectives were: 1) to explore perceptions regarding the use of a mobile app as a supplementary tool for improving and maintaining oral health; and 2) to evaluate the impact of using a mobile app, in conjunction with dental hygiene appointments, on gingival inflammation, oral hygiene levels, and motivation for oral health self-care.

MATERIALS AND METHODS

This study was approved by the Health Ethics Committee of the Faculdade de Medicina Dentária da Universidade de Lisboa (FMDUL) (ref: CE-FMDUL202160) and followed the CONSORT statement for randomized clinical trials,[31] except for clinical trial registration.

An exhaustive search was carried out in both Google and Apple stores to identify free apps that were easy to use and matched the objectives of this study. To ensure a meaningful comparison, 2 apps with distinct functionalities were intentionally chosen: *Brush DJ* (a widely used app that provides only a timer with music for toothbrushing, without visual guidance, available in both the Apple Store and in Google Play) and *DentalCluj Brush Assistant* (an app offering guided toothbrushing with visual support, available until 2023 exclusively in Google Play). This selection allowed the research team to assess potential differences in effectiveness between a simple timer-based approach and a visually guided brushing experience. The 2 apps were chosen after a review of the available apps with the following features: reminders for toothbrushing, information on oral disease prevention, brushing guidance through images, timers, and/or text, being free of charge, available in Portuguese or English, and easy to install on mobile devices. Additionally, the selection criteria included a focus on young adults and the absence of any association with a specific toothbrush or brand.

The study was a single-blind randomized clinical trial with a parallel repeated measures design and a ratio allocation of 1:1:1. It included 2 experimental groups (A and B) and a control group (C). The experimental groups were exposed to 1 of the 2 selected apps (depending on the smartphone used, whether iOS or Android), while the control group was not exposed to any app. The experimental and control groups proceeded simultaneously and independently throughout the study.

A non-probabilistic sample included FMDUL students from the first and second years of the Bachelor of Dental Laboratory Technology program. A minimum of 8 participants per group was sought. This value was calculated with an online application (epitools.ausvet.com.au/) using the following parameters: significance level of 0.05, power of 0.80, and difference between means of 3. The outcome used to generate the sample size calculation was the simplified oral hygiene index (OHI-S).

Participants were selected based on the previously defined inclusion and exclusion criteria. Students who owned a smartphone, were between the ages of 18 and 20 years, and signed the informed consent form were included in the study. Exclusion criteria were the use of an electric toothbrush, the previous use of an app for oral health self-care, not having basic knowledge of English, or having a systemic disease that affects oral health.

Data were collected using an initial questionnaire, a final questionnaire, and 3 intraoral examinations

during the study. Two dental hygienists with experience in questionnaire research reviewed the questionnaires to verify the relevance and content of the questions. A pretest was conducted with 6 young individuals aged 18 to 20 years, and necessary adjustments were made based on their feedback.

Data collection occurred between February and April 2023 and consisted of the following phases, which will be described in detail below: 1) selection of the participants; 2) baseline examination and dental hygiene appointment; 3) intermediate examination; 4) final examination.

Selection of the participants

Participants were selected on the dental school premises at the start of a lesson. Students who agreed to participate provided informed consent and completed the initial questionnaire. This questionnaire collected sociodemographic data and information on relevant health problems, the operating system of the participant's smartphone, oral health perception, and oral health behaviours. At that time, a dental hygiene appointment was also scheduled.

An individual identification number was assigned to each participant to permit simple randomization and the matching between the 3 study periods.

Baseline examination and dental hygiene appointment

The baseline examination was performed using a WHO CPI probe and an oral dental mirror,[32] and the dental hygiene appointment took place at the university clinic. The examination included registering the participant's DMFT index according to WHO criteria,[32] the (OHI-S),[33] and the bleeding on probing (BOP) index.[34] No dye was used to record the OHI-S, and only the CPI probe was used to assess the soft deposit component. A previously trained and calibrated examiner (dental hygienist) measured all the indices.

After the indices were completed, the same investigator made a dental hygiene appointment for all the participants, which included calculus removal with ultrasound, polishing, and self-care instruction, using a previously established script (demonstration of toothbrushing by the modified Bass method and discussion of the importance of flossing, without demonstration).

After the appointment, a second team member accompanied each participant to another clinic room for the simple random allocation to the study groups, as the examiner was blind to this allocation. Each of the 24 participants, previously selected and meeting the study's inclusion and exclusion criteria, were numbered and listed, and then a simple random and sequential choice (A: *DentalCluj Brush Assistant*; B: *Brush DJ*; C: Control) was made for each of the groups, thus allowing all groups to have an equal number of participants. The randomization was assisted by the app *Research Randomizer* (randomizer.org/).

Participants allocated to the experimental groups were asked to download the app, and a brief explanation of the app's features was given using a previously established script with clarifying images. These participants were requested to use the app during the study and record their use and toothbrushing in a calendar provided by the research team's registrar. The control group participants received no app but were also asked to record their toothbrushing in a calendar. All participants were instructed to use their usual toothbrush and toothpaste. The group allocation was made by a member of the research team who recorded the data and who did not measure the indices in order to make this examiner blind to the exposure (use of the app or not). The only difference between the groups was the use of the app to promote oral self-care after the appointment.

Intermediate examination

The intermediate clinical examination was conducted 15 days after the baseline examination under the same environmental conditions. The OHI-S and BOP indices were recorded again in the same manner as at baseline. The same blind examiner performed all procedures, and the participants were instructed ahead of time not to mention the group to which they had been allocated.

Final examination

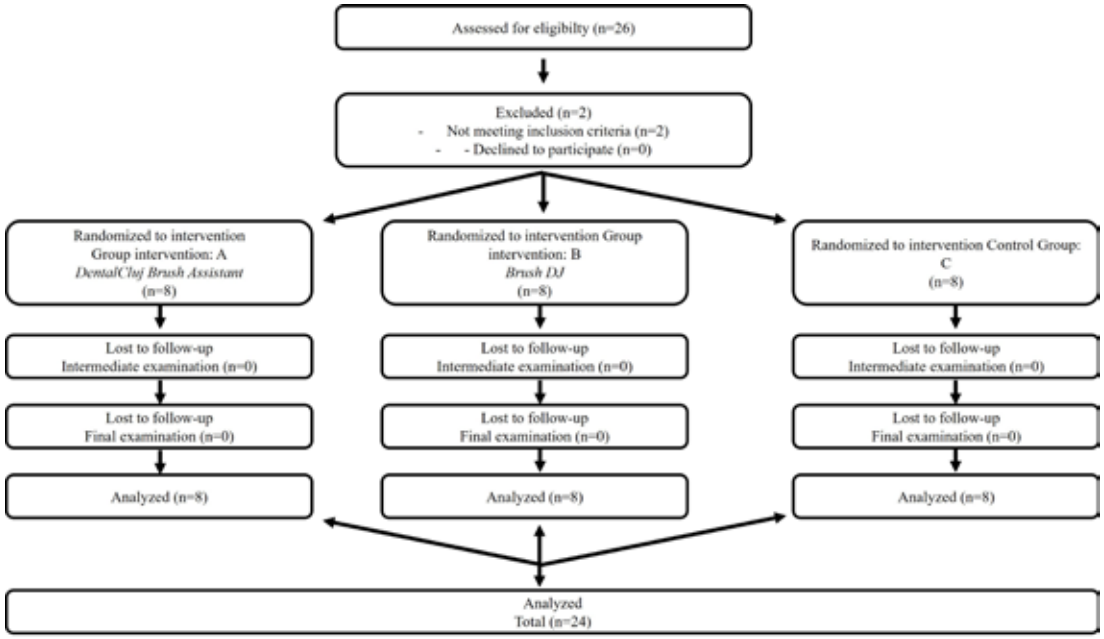
The final examination took place 15 days after the intermediate exam, using the same procedures under the same conditions. After the final examination, participants were asked to return the toothbrushing and app frequency calendars and take the final questionnaire. The latter collected information about oral hygiene behaviours and, in the experimental groups, the participants' opinions about the app used.

A flow diagram of the study, following the CONSORT guidelines, is presented in Figure 1.

Data analysis

Data were analyzed using the Statistical Package for Social Sciences, version 27 (SPSS® 27.0). Absolute and relative frequencies of the variables were calculated, as well as the mean and standard deviation (sd) for numerical variables. The Kruskal-Wallis, Wilcoxon, Friedman, and Mann-Whitney tests were used ($\alpha = 0.05$). The Kruskal-Wallis test was used to assess differences between the 3 independent groups of the study in terms of DMFT, OHI-S, and BOP (at baseline and the end of the study). The Wilcoxon test was applied to analyze differences between 2 conditions for paired samples, namely to assess the differences in the frequency of toothbrushing and flossing between baseline and the end of the study. The Friedman test was used for the 3 paired conditions to assess differences in the OHI-S and BOP, comparing the 3 periods (baseline, midpoint, and final examinations). Finally, the Mann-Whitney test was used to compare differences between the 2 groups of app users regarding the number of times the app was used during the study.

Figure 1. Study flow diagram



RESULTS

The study sample included all 24 previously recruited individuals, equally and randomly distributed into the 3 study groups. No exclusions occurred after randomization. The mean age of the participants was 18.5 years (sd = 0.51). Table 1 presents the characteristics of the sample.

When the frequency of toothbrushing and flossing was compared between the baseline and end of the study, there were no significant differences in any of the groups ($p > 0.05$) (Table 2).

The groups were compared using baseline records, considering each oral health index. The baseline mean DMFT was 3.67 (sd = 3.17), and no significant differences were found between the groups ($p > 0.05$). The component that most contributed to the DMFT was filled teeth (88.6%), with a few untreated dental caries (6.8%) and missing teeth (4.6%). There were also no significant differences at baseline in the OHI-S ($p > 0.05$). However, the BOP index had a better percentage in the *Brush DJ* group compared to the *Dentalcluj Brush Assistant* group ($p = 0.007$) and the control group ($p = 0.03$).

Comparing the groups over the 3 examination stages of the study, all groups showed a tendency, not always significant, to improve the oral health indices. There were significant differences in the control group ($p = 0.02$) and the *Dentalcluj Brush Assistant* group ($p = 0.004$) on the OHI-S. For the BOP index, there were only significant differences in the *Dentalcluj Brush Assistant* group ($p = 0.02$). The differences were always between findings at baseline and at the end of the study (Table 3).

According to the calendars completed by the participants, the mean number of times they used the app was 15.1 (sd = 15.3), considering the total weeks of the study. There was a general descending trend in using both apps, but it was less evident in the *Dentalcluj Brush Assistant* group. The mean number of times was higher in the *Dentalcluj Brush Assistant* group (18.3 ± 15.1) than in the *Brush DJ* group (11.4 ± 15.8) but with no significant differences ($p = 0.12$) (Table 4).

Half of the participants in the experimental groups found the app useful (75% in the *DentalCluj Brush Assistant* group and 25% in the *Brush DJ* group). The app most often used, most recommended, and most likely to be used in the future was the *Dentalcluj Brush Assistant* (Table 5).

The participants highlighted both positive and negative aspects of using the apps. The most positive elements mentioned were "the support in brushing technique because it is demonstrated visually" and the "timer." The timer was mentioned in reference to both mobile apps, while the help with brushing technique was often mentioned in the *Dentalcluj Brush Assistant* group. The most negative aspects of both apps were as follows: "not practical," "wasting more time," and "having to take the phone to the toilet." In the *Dentalcluj Brush Assistant* group, the aesthetics/design ("not being in the Portuguese language" and "after using 2 or 3 times, it becomes memorized") were also mentioned as negative aspects. Similarly, the *Brush DJ* group participants noted that "It has few songs associated with it" and "After the first time, it may no longer be necessary to continue using it."

Table 1. Sociodemographic characteristics, oral health perceptions, and oral health appointment attendance of study participants

Study participants (N = 24)			
		%	n
Sex	Female	75.0	18
	Male	25.0	6
Age	18 years old	50.0	12
	19 years old	50.0	12
Oral health perception	Very bad	0.0	0
	Bad	4.2	1
	Reasonable	29.2	7
	Good	54.2	13
	Very good	12.5	3
Frequency of oral health care appointments	Never	0.0	0
	Less than a year	12.5	3
	Once a year	58.3	14
	Twice a year or more	29.2	7
Reason for last oral health care appointment	Routine	33.3	8
	Dental treatment	20.8	5
	Pain	16.7	4
	Oral hygiene	16.7	4
	Tooth extraction	4.2	1
	Orthodontics	4.2	1
	Don´t remember	4.2	1

DISCUSSION

Apps can have features that promote better oral health and that encourage more positive behaviours by supporting patients in their daily oral care routines and providing information through images and demonstrations.[20,22,35] They can also be helpful for oral health professionals, creating a closer relationship with the patient.[36]

However, the effectiveness of apps in improving oral health indices is contradictory. Some studies show improvement in the experimental groups, while others found no differences between the experimental and control groups.

A 3-month study found that the behaviours and attitudes of high school students after experiencing 1 of 2 forms of oral health education (*Brush DJ* app or conventional oral health education sessions) were similar.[35] In the present study, the *Dentalcluj Brush Assistant* group had 2 participants who reported starting to use dental floss, and a third reported using it more frequently. Although these differences were not significant, these results should be considered, as this app seems to impact the motivation for oral health self-care, particularly in terms of flossing.

No significant differences were found between the baseline and final OHI-S and BOP index in the *Brush DJ* group. Another study, which investigated the effect of the same app for 12 weeks on adolescent orthodontic patients, found significant improvements in the experimental group's plaque and gingival indices. In the same study, the frequency of app use was also positively correlated with the frequency and duration of toothbrushing.[24]

In the *Dentalcluj Brush Assistant* experimental group and the control group, oral hygiene (OHI-S) improved significantly from baseline to the end of the study. The improvement was much more evident in the experimental group, which could highlight the potential of using an app to complement a routine oral health appointment and to reinforce the dental hygienist's instructions.

The potential of using an app to improve oral health indicators is also reinforced by the finding in the present study that gingival inflammation (BOP index) in the *Dentalcluj Brush Assistant* group improved, the only group to record significant differences between the baseline and final examinations in this index. This result is supported by a literature review that indicated a significant reduction in biofilm in experimental app groups compared to control groups.[23]

Although no significant differences were found in the oral health indices of the *Brush DJ* experimental group, this group started the study with a lower BOP index when compared to the others. This baseline difference may have influenced the results, as participants with lower initial levels of gingival inflammation had less room for improvement, making it more difficult to detect significant reductions in BOP over time. Gingival inflammation in this group did improve, but not significantly, although the p value was close to the statistical decision limit ($p = 0.08$). Unlike the other experimental group, the OHI-S did not improve significantly in this *Brush DJ* group. The better results of the *Dentalcluj Brush Assistant* group could be related to the characteristics and features of the app. This app does not just have a timer, like *Brush DJ*; it offers other features considered positive by the participants, namely the visual monitoring of toothbrushing step-by-step, which can motivate individuals to improve their technique and consequently their oral health indices.

Table 2. Comparison of oral hygiene behaviours between baseline and end of the study

Oral hygiene behaviour		Control		P^a	*Dentalcluj Brush Assistant*		P^a	*Brush DJ*		P^a
		Baseline	Final		Baseline	Final		Baseline	Final	
		% (n)			% (n)			% (n)		
Toothbrushing	Daily	25.0 (2)	25.0 (2)	1.0	12.5 (1)	12.5 (1)	1.0	0.0	0.0	1.0
	Twice/day	75.0 (6)	75.0 (6		87.5 (7)	87.5 (7)		100 (8)	100 (8)	
Flossing	Do not use	25.0 (2)	25.0 (2)	1.0	50.0 (4)	25.0 (2)	0.2	12.5(1)	12.5 (1)	1.0
	Less than once a week	0.0	0.0		0.0	12.5 (1)		0.0	12.5 (1)	
	Once/week	50.0 (4)	50.0 (4)		37.5 (3)	37.5 (3)		62.5 (5)	62.5 (5)	
	Once/day	25.0 (2)	25.0 (2)		12.5 (1)	25.0 (2)		25.0 (2)	25.0 (2)	

[a]Wilcoxon test

Table 3. Comparison by group of OHI-S and BOP at baseline, midpoint, and end of the study

Index		Control	P^a	*Dentalcluj Brush Assistant*	P^a	*Brush DJ*	P^a
OHI-S	Baseline	0.83^x	**0.02**	1.04^x	**0.004**	0.73	0.08
	Intermediate	0.50^{xy}		0.71^{xy}		0.42	
	Final	0.38^y		0.50^y		0.38	
BOP	Baseline	34.0%	0.22	38.7%^{x}	**0.02**	18.1%	0.28
	Intermediate	27.1%		29.0%^{xy}		20.8%	
	Final	26.2%		26.5%^{b}		15.4%	

[a]Friedman test with multiple comparisons
The *P* values in bold type show statistically significant differences ($P < 0.05$)
Values that share the same letter do not have statistically significant differences

Table 4. Mean number of times the app was used during the study

App	Week 1	Week 2	Week 3	Week 4	Total for the study	P^a
Dentalcluj Brush Assistant	5.29	4.75	4.38	4.50	18.25	0.12
Brush DJ	4.00	2.57	2.57	2.29	11.43	
Total	4.64	3.73	3.53	3.47	15.07	

[a]Mann-Whitney U-test

Table 5. Participants' perceptions and use of the apps

		Dentalcluj Brush Assistant % (n)	*Brush DJ* % (n)	Total % (n)
Frequency of use	Never	0.0 (0)	12.5 (1)	6.3 (1)
	Rarely	12.5 (1)	50.0 (4)	31.3 (5)
	Frequently	50.0 (4)	25.0 (2)	37.5 (6)
	Often	37.5 (3)	12.5 (1)	25.0 (4)
Utility	Yes	75.0 (6)	25.0 (2)	50.0 (8)
	No	25.0 (2)	75.0 (6)	50.0 (8)
Reasons the app is considered helpful	Motivated me to brush my teeth at least twice a day	0.0 (0)	0.0 (0)	0.0 (0)
	Taught me how to brush my teeth using the proper technique	75.0 (6)	37.5 (3)	56.3 (9)
	Helped me to brush my teeth for as long as necessary	75.0 (6)	37.5 (3)	56.3 (9)
	Other	33.3 (1)	0.0 (0)	33.3 (1)
Limitations	Yes	12.5 (1)	12.5 (1)	12.5 (2)
	No	87.5 (7)	87.5 (7)	87.5 (14)
Future use of the app	Yes	62.5 (5)	0.0 (0)	31.3 (5)
	No	37.5 (3)	100 (8)	68.8 (11)
App recommendation	1 – would not recommend	0.0 (0)	28.6 (2)	13.3 (2)
	2	12.5 (1)	28.6 (2)	20.0 (3)
	3	25.0 (2)	28.6 (2)	26.7 (4)
	4	37.5 (3)	14.3 (1)	26.7 (4)
	5 – very likely to recommend	25.0 (2)	0.0 (0)	13.3 (2)

The literature shows that information given verbally, accompanied by written messages, images, and demonstrations, produces better results in changing risk behaviours for oral health.[37] In fact, modelling behaviours through video has shown potential benefits in clinical practice, facilitating the acquisition of knowledge and improving self-care.[38] This improvement supports the theory of self-efficacy, developed by Bandura in 1977,[39] which states that behaviour can be changed by an individual's beliefs in their abilities to control the events that affect their routines.[39] The use of mHealth apps can be a suitable method for improving individuals' self-efficacy, particularly in more time-consuming and technical procedures, such as toothbrushing and flossing regularly. Some other studies that have analyzed the impact of apps with the step-by-step toothbrushing functionality, similar to Dentalcluj Brush Assistant, concluded that their use contributed to improving oral health indicators.[20,29]

Despite the positive and promising results for the *Dentalcluj Brush Assistant* experimental group, there were also significant differences in the OHI-S in the control group, indicating that using apps is not a substitute for direct communication between oral health professionals and patients.[35,40] The use of apps, especially those that

reinforce oral hygiene techniques step-by-step, seem to be helpful, primarily if used as a complement to the dental hygiene appointment, motivating the patient and reinforcing instructions over time, and helping the oral health professional during the appointment, complementing their communication and eventually reducing the length of the appointment.

A study conducted in young Portuguese adults revealed that about 73% of the participants considered an app for oral health motivation helpful, although only 6.1% reported using one.[41] In the present study, only 50% of the participants considered using these apps beneficial, and their frequency of use decreased over the weeks of the study, especially in the *Brush DJ* group. Additionally, using an app can be discouraging over time because it becomes repetitive. Both the positive and negative aspects and the limitations identified by participants explain the frequency of use of the app and its recommendation. The literature highlights various features valued by users of oral health apps, such as providing information, timer, brushing record, sharing information with the health professional, being free, easy to use, and saving time.[9,12,41,42] The characteristics that most pleased and displeased the participants should be considered when choosing an app to advise a patient and when developing new oral health apps.

Although this study had a small convenience sample, which limits the generalizability of the results, it could serve as an exploratory study into young people's perceptions of using oral health apps in the Portuguese population. As a non-probabilistic sample, the study included students with less contact with oral disease prevention methods, no clinic or patient training, and at the beginning of their academic training. More studies are necessary, but apps related to oral health promotion seem to be a valuable and appealing tool for improving the population's health indicators. Oral health professionals can use these technologies to promote their patients' oral health, making their demonstrations more appealing and facilitating the communication process with the patient.

CONCLUSION

Using an app with a step-by-step explanation of toothbrushing technique, such as *DentalCluj Brush Assistant*, can significantly improve oral hygiene and gingival inflammation. A considerable number of the participants considered it helpful to use an app to support their oral health self-care. The most positive aspects highlighted were the brushing monitoring (with step-by-step toothbrushing technique), the information on oral diseases, the oral health appointment reminders, and the toothbrushing timer.

The results of this study confirm that an app can be a valuable tool for supporting the oral hygiene of young adults as a complement to an oral health care appointment. The features mentioned by the participants may be important to consider when choosing an app to advise patients and developing new apps to improve oral health self-care.

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CONFLICTS OF INTEREST

The authors have declared no conflict of interest.

DISCLOSURE OF AI-GENERATED CONTENT

To prepare this manuscript, the authors used Grammarly to help with the manuscript translation and writing quality. Before adding the translation to the submission, the authors reviewed and corrected it, as required, and take full responsibility for its content.

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