Original Article

Effects of a Mobile Application to Improve Oral Hygiene in Children

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ABSTRACT

Aim: Dental caries is one of the most common chronic diseases which affects oral health. Tooth brushing is considered the most effective method of preventing dental caries. Providing this motivation and ensuring this habit can be difficult, especially in children. Novel methods for improving tooth brushing habits are desired. This study aimed to investigate a mobile application's effectiveness in improving oral health in children.

Materials and Methods: Two hundred children between 5-12 years old who applied to the Department of Pedodontics, Ege University Faculty of Dentistry, for routine dental examination were included in this study. Children who had any systemic, physical, and/or mental disorders or those who had emergency dental complaints were not included in this study. A structured questionnaire including the child's oral hygiene habits was completed by the parents. In the clinical examination, the caries indices (DMFT/dmft and DMFS/dmfs), dental plaque, and gingival index scores of the children were recorded. Following this clinical examination, the "Brush DJ" mobile application was introduced to the children and their parents. After the first examination, the children were referred for their dental treatment and all were recalled after three months. At the recall examination, a second questionnaire was completed by the parents. The dental caries index (DMFT/dmft and DMFS/dmfs) scores, dental plaque, and gingival index scores were recorded again. A parental satisfaction questionnaire was administered to the parents. Statistical analysis was carried out using the SPSS 25.0 software program. The compliance of the parameters to the normal distribution was evaluated via the Shapiro-Wilk test. The Mann-Whitney U and Kruskal-Wallis tests were used for comparisons between the groups. For intra-group comparisons, the Wilcoxon test, chi-square test, Fisher's Exact test, and t-test were used. The results were evaluated at a 95% confidence interval and a statistical significance level of $p < 0.05$.

Results: It was determined that 56.5% (n=113) of the children participating in this study were girls and 43.5% (n=87) were boys. One hundred and seventy-one of the 200 children were reported to be using the mobile application. It was observed that the tooth brushing frequency increased in 97 children due to their use of the mobile application. It was also observed that the tooth brushing duration increased in 143 of 171 children as a result of their use of the application. Initial plaque and gingival index scores (1.59±0.40; 1.18±0.40, respectively) were statistically higher than the recall examination scores (1.29±0.46; 1.09±0.49 respectively) ($p < 0.05$). Based on the parental satisfaction survey data, it was observed that the use of the mobile app was effective in improving tooth brushing habits, and brushing became more regular and enjoyable in all children.

Conclusion: It was concluded that using the "Brush DJ" mobile tooth brushing app is effective in improving oral hygiene habits and making it a regular behavior in children. Long-term follow-up studies with a larger number of subjects comparing different oral hygiene education methods should be planned.

Keywords: Brush DJ, oral hygiene, pediatric dentistry

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Introduction

Oral health plays an important role in protecting and maintaining general health. Oral and dental health problems are among the most common public health problems worldwide. Untreated oral and dental problems can often cause conditions which negatively affect general health, such as pain, chewing and feeding problems, loss of weight, and developmental deficiencies. Oral and dental health problems negatively affect quality of life (1-4).

Dental caries and periodontal diseases are among the most common oral and dental health problems. Dental caries affects 90% of the population (5-7). It has been observed that in developed countries with high socioeconomic status, these problems have started to decrease with proper oral hygiene habits, lower sugar consumption, widespread dental services, and regular dental visits (7-9). In developing countries, these problems continue to increase for many reasons; inadequate oral care and personal hygiene, inappropriate food and beverage consumption, irregular nutrition, inadequate preventive dentistry services, lack of regular dental visits, etc. (10-12).

Dental caries and periodontal diseases are caused by dental plaque, an organized form of biofilm. The most effective method to prevent dental plaque formation is brushing the teeth (13). Dentists need to encourage patients and their parents to practice these habits properly and regularly. These habits should be acquired from an early age through training which can be considered very easy and economical to implement. Training on oral and dental health has become an important part of preventive programs (14,15).

In recent years, mobile technology has revolutionized various aspects of our lives, including healthcare. One area where mobile apps have made a significant impact is oral hygiene. With the increasing accessibility of smartphones and the development of innovative dental care applications, individuals now have powerful tools at their fingertips to improve their oral health (16-18). Mobile apps serve as valuable educational tools, providing users with comprehensive information about proper oral hygiene practices, including brushing techniques, flossing methods, and the importance of regular dental visits. These apps often feature interactive tutorials, videos, and informative articles authored by dental professionals, empowering users to make informed decisions about their oral health (16,18).

Brush DJ, which was examined in the present study, was developed to motivate evidence-based oral hygiene routines and use the advantages offered by mobile applications.

The British Pediatric Dentistry Association gave an award to Benjamin Underwood for creating the Brush DJ application (Outstanding Innovation Award 2018) (19).

The aim of developing this application was to encourage children to acquire improved brushing habits so as to contribute to their oral hygiene development. Within the scope of this application, reminders can be sent to the users on topics such as dental visits, how regularly they should replace their toothbrushes, the number of times they should brush their teeth per day, using mouthwash, etc. (19,20).

This study aimed to investigate the effectiveness of this mobile application, which can be downloaded freely to smartphones, in improving oral health in children.

Materials and Methods

This study included 200 children between 5-12 years old who applied to the Department of Pedodontics, Ege University Faculty of Dentistry, for a routine dental examination, who did not have any systemic, physical, and/or mental illness, did not use any medication and who did not have any emergency dental complaints. Ethical approval was obtained from the Ege University Faculty of Medicine, Medical Research Ethics Committee (approval no.: 21-3.1T/49, date: March 18th, 2021), and written informed consent was obtained from each parent.

An eleven-question survey was administered to the children and their parents before the clinical examination. Their initial oral and dental health status and oral hygiene habits were recorded. Dental caries (DMFT/dmft and DMFS/dmfs) (21) and periodontal indices [Silness & Löe plaque index (PI) and gingival index (GI)] scores were recorded (22,23).

Information was given about the "Brush DJ" application to the children and their parents and the application was installed on their smartphones. An alarm was set for the children to brush their teeth in the morning and in the evening. The application sends notifications such as "Good morning, time to brush your teeth" or "Good evening, time to brush your teeth" to remind the users. The application also reminds the users to brush their teeth for two minutes. During this period, it is aimed to make the act of brushing teeth more enjoyable for the children by playing music selected from the music lists in the application or the music lists from the user's smartphone. When the time is up, the music stops and the tooth-brushing action is terminated with a clapping effect.

To evaluate the effectiveness of this application, children were recalled three months later. In the third month follow-up, a nine-question survey was carried out in order to evaluate oral hygiene habits. Dental caries index (DMFT/dmft and DMFS/dmfs) scores, dental PI, and GI scores were recorded again. The Parental Satisfaction Survey consisting of five questions, scored out of 5 (1-5 points, from "strongly disagree" to "strongly agree") according to Likert scaling was performed on the parents.

Statistical Analysis

Statistical analysis was carried out using the SPSS 25.0 (SPSS Inc., Chicago, Illinois, USA/Statistical Package for the Social Sciences) software program. The compliance of the parameters with normal distribution was evaluated with the Shapiro-Wilk test. The Mann-Whitney U and Kruskal-Wallis tests were used for comparisons between the groups. For intra-group comparisons the Wilcoxon test, chi-square test, Fisher's Exact test, and t-test were used. The results were evaluated at a 95% confidence interval and a statistical significance level of $p<0.05$.

Results

The mean age of the 200 children was 8.13±2.10 years. It was determined that 56.5% (n=113) of the children were girls and 43.5% (n=87) were boys. One hundred and seventy-one of the 200 children were reported to be using the mobile application. It was observed that tooth brushing frequency increased in 97 children due to their use of this mobile application. It was also observed that the tooth brushing duration increased in 143 out of 171 children as a result of using this application.

A comparison of the baseline and follow-up caries index (DMFT/dmft and DMFS/dmfs) scores is given in Table I and II. No statistically significant differences were detected between these scores ($p>0.05$).

A comparison of the baseline and follow-up PI and GI scores is given in Table III. Baseline PI and GI scores were statistically significantly higher than the third-month follow-up scores ($p<0.05$).

Table I. Comparison of the baseline and check-up caries index scores for primary teeth

	Baseline (T0) (Mean ± SD)	3rd month follow-up (T1) (Mean ± SD)	p value
dmft	6.10±3.72	6.16±3.74	0.236
dmfs	14.0±9.72	15.23±10.82	0.152
SD: Standard deviation			

Table II. Comparison of the baseline and check-up caries index scores for permanent teeth

	Baseline (T0) (Mean ± SD)	3rd month follow-up (T1) (Mean ± SD)	p value
DMFT	1.66±2.07	1.70±2.11	0.218
DMFS	2.78±3.85	2.81±3.88	0.391
SD: Standard deviation			

Table III. Comparison of baseline and check-up periodontal index scores

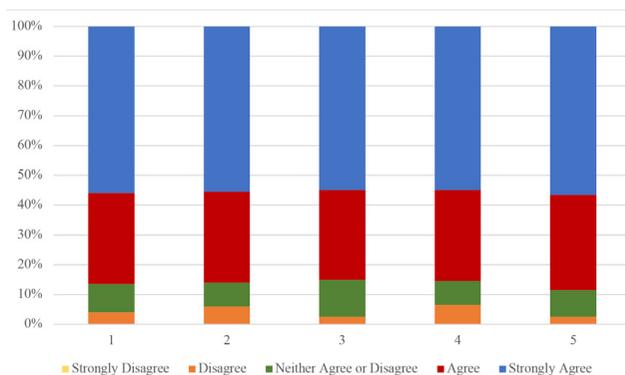|	Baseline (T0) (Mean ± SD)	3rd month follow-up (T1) (Mean ± SD)	p value
PI	1.59±0.40	1.29±0.46	0.00*
GI	1.18±0.40	1.09±0.49	0.00*
*p<0.05 Statistically significant SD: Standard deviation, PI: Plaque index, GI: Gingival index			

Figure 1. Responses for the parental satisfaction survey

The responses to the Parental Satisfaction Survey are given in Figure 1. Based on the parental satisfaction survey data, it was observed that the use of the mobile app was effective in improving tooth brushing habits, and brushing became more regular and enjoyable in all children.

Discussion

It was aimed to effectively ensure oral hygiene in children by informing and motivating both children and their parents in the present study. Oral and dental health affects general health. Although the necessity and importance of oral hygiene habits in improving oral and dental health are known by many individuals, it has been observed that there are inadequacies in the implementation of these habits, especially in children. Oral and dental health depends on individuals practicing oral hygiene habits correctly and regularly (24,25). It is accepted that the most effective way to prevent dental caries and periodontal diseases is

through continuous individual oral hygiene practices and professional care (25).

Newly developed technologies and interactive applications create new environments and opportunities to provide health services. Using smartphones and the internet to communicate directly and quickly with healthcare providers can improve health management, especially for children and adolescents. Practices and studies on health are extremely important in terms of protecting and improving health. Mobile apps have emerged as valuable tools for promoting better oral hygiene practices and enhancing dental care outcomes. By providing education, reminders, personalized recommendations, and telehealth services, these apps empower individuals to take proactive control of their oral health. As technology continues to evolve, the integration of mobile apps into dental care workflows holds great promise for improving overall oral hygiene and reducing the prevalence of dental problems in the population (26). This study aimed to investigate a mobile application's effectiveness in improving oral health in children. For this reason, Brush DJ, a mobile application which can be downloaded freely on smartphones, was introduced to 200 children aged between 5-12 years old who were referred for routine dental examination.

At baseline and third-month follow-up visits, structured questionnaires were completed by the parents. The dental caries and periodontal index scores of the children were recorded. A parental satisfaction questionnaire was also administered to the parents.

Underwood et al. (19) also evaluated the user perception of the Brush DJ mobile tooth-brushing application. They reported that 77% of the participants stated that they brushed their teeth twice a day with the use of this application, and 88% stated that their duration of tooth brushing increased as a result of using this app (19). In the present study, 171 of the 200 children were reported to be using the mobile application. It was observed that the tooth brushing frequency increased in 97 children due to using this mobile application. It was also observed that the tooth brushing duration increased in 143 out of 171 children as a result of using the application.

When comparing the caries index (DMFT/DMFS, dmft/dmfs) scores, no statistically significant differences were detected between the baseline and follow-up scores in either the primary or the permanent teeth (p>0.05). It is thought that this result may change with long-term use of this mobile application.

In the study by Farhadifard et al. (27), in which the conventional oral hygiene education method and Brush DJ application were compared in patients receiving orthodontic treatment, it was reported that there was a significant decrease in PI and GI scores in both the control and test groups compared to the baseline scores and this decrease was higher in the group using the mobile application (27). Similarly, Alkadhi et al. (28) reported a decrease in PI and GI scores in the control and test groups, and these values were significantly lower in the mobile application group. Similar to the previous studies, the baseline PI and GI scores were statistically significantly higher than the third-month check-up scores in the present study (p<0.05).

It was also reported that 70% of the children started to brush their teeth more carefully and felt cleaner after using the Brush DJ mobile application (19). Similarly, in the present study, the rate of children who stated that they were motivated to brush their teeth at the end of the third month was 86%. Based on the parental satisfaction survey data, it was observed that the use of the mobile app was effective in improving tooth brushing habits, and brushing became more regular and enjoyable in all children. According to the responses to the parental satisfaction survey, it was observed that the parents were satisfied with their children using the Brush DJ mobile application.

Conclusion

The Brush DJ mobile application, which can be downloaded freely to smartphones was developed to motivate oral hygiene routines. Given the increasing demand for health-related mobile applications and the societal trend toward using technology to support healthy behaviors, it is extremely important to investigate the effectiveness, efficiency, and acceptability of oral and dental health-related applications. The Brush DJ mobile application evaluated in the present study was found to be effective in motivating oral and dental health in children. It is thought that the results of this study will be a guide for future studies on oral and dental health education, which has an important place within the scope of preventive dentistry.

While mobile apps have the potential to improve oral hygiene practices significantly, there are certain challenges and considerations to address. These include ensuring the accuracy and reliability of the information provided within these apps, safeguarding user privacy and data security, and addressing disparities in access to technology among different demographics. Furthermore, it is essential to

promote evidence-based practices and collaborate with dental professionals in order to ensure that mobile apps complement, rather than replace, traditional dental care services.

Long-term follow-up studies with larger numbers of subjects comparing different oral hygiene education methods should be planned.

Ethics

Ethics Committee Approval: Ethical approval was obtained from the Ege University Faculty of Medicine, Medical Research Ethics Committee (approval no.: 21-3.1T/49, date: March 18th, 2021).

Informed Consent: Written informed consent was obtained from each parent.

Authorship Contributions

Surgical and Medical Practices: S.S.Ö., D.Ç., Concept: S.S.Ö., D.Ç., Design: S.S.Ö., D.Ç., Data Collection and/or Processing: S.S.Ö., D.Ç., Analysis and/or Interpretation: S.S.Ö., D.Ç., Literature Search: S.S.Ö., D.Ç., Writing: S.S.Ö., D.Ç.

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