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ARTICLE NAME: EVALUATING CHILD TOOTHBRUSHING BEHAVIOR CHANGES ASSOCIATED WITH A MOBILEGAME: A SINGLE PRE-POST PLOT STUDY

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**Sammary**

**In the article “Evaluating Child Toothbrushing Behavior Changes Associated with a Mobile Game: A Single Arm Pre-Post Pilot Study” published in Pediatic Dentistry July 15, 2019. Dov Jacobson, Jesse Jacobson, Traci Leona at al. conducted a study that took place in Atlanta, Georgia. This pilot study had the aim of analyzing improvements in toothbrushing behaviors associated with a mobile game device.** **Thirty-four children ages five to six-year-olds were trained using the adversary of the Brush Up game and spent seven days at home once a day playing it. After seven days, the length of kids toothbrushing significantly improved. For kids who played the game for 14 days, even greater changes were found in consistency and delivery. Improvements in toothbrushing did not continue one year later without further use of the device, but improvements were reported which could be clinically significant.** **Mobile safety games in children may actually improve the quality of kids toothbrushing. Additional testing is required to assess mobile toothbrushing games.**

**Article Information**

**Evaluating Child Toothbrushing Behavior Changes Associated with a Mobile Game: A Single Arm Pre-Post Pilot Study.**

**Dov Jacobson, Jesse Jacobson, Traci Leona at al.**

**Published In Pediatic Dentistry July 15, 2019.**

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6709707/>

GamesThatWork developed the Brush Up game and has an ongoing interest in its success. Two authors (JJ, DJ) are principals of GamesThatWork.

**Study Analysis:**

**Review of literature, was conducted in Atlanta, Geogria in a laboratory and at home settings**

**Study Purpose:**

**Tooth decay is a multifactorial disorder that can be avoided through routine toothbrushing. Reports indicate about 80 per cent of children brush twice daily, but actual rates may be lower due to overreporting. Most parents have challenges in maintaining toothbrushing practices and an older survey found that children frequently overlook tooth surfaces during toothbrushing.** **Such reasons highlight the importance of developing strategies for enhancing toothbrushing in childhood.** **Many households possess apps that give them access to electronic health games.10 Two systematic reviews recorded limited support for video games,11–12 but it was noted that the initial approaches were passive (e.g., sms alerts, monitoring), making it likely that the issue was poor intervention design. As far as toothbrushing games are concerned, a UK. Research surveyed 189 consumers of mobile game toothbrushing aged 7–75 (e.g. how smooth the teeth feel after using the game).13 The majority of users were adults, the app was not geared to children and the study focused on attitudes rather than habits.** **A second study identified a potential method for a toothbrushing game for Dutch teens.14 Internet coaching, text messages, and "selfie" photos were investigated by dental researchers as ways to improve toothbrushing but none were commercially s** **Online children's toothbrushing apps have become popular despite the lack of evidence to prove efficacy. The goal of this pilot study was to test the toothbrushing game of a commercially available smartphone kids called Brush Up and to determine whether the game could potentially help improve toothbrushing behaviour. We checked the theory that game play would be related to changes in the efficiency of the toothbrushing.**

Experimental:

**In June and July 2012, children aged 5–6 years were recruited from mixed-income communities in Atlanta, Georgia, by flyers displayed in local stores, colleges, and libraries. Participants were also interviewed in-person by a Research Assistant at parking lots at local grocery store. The intention was to hire a convenient sample of 34 students, which is what the limited budget of the study required. There were no estimates on sample size a priori. Criteria for exclusion is psychological, cognitive, or physical disorders which may conflict with toothbrushing or gaming. At the end of the study, every family that participated received $200 as a gift of gratitude. The thesis had been accepted by the IRB Medicine School in Morehouse. In a GamesThatWork workshop decorated as a bathroom with a sink and mirror, both kids brushed their teeth with a manual toothbrush. The child didn't receive any parent, teacher, video, game, audio, or clock brushing guidance. Both trips to the toothbrushing had been videotaped. Caregivers could observe through a small one-way window. Identical procedures took place during subsequent study visits.**

**After the evaluation assessment, a Research Assistant taught children how to use Brush Up. Every child has been sent home with a sensor-enabled toothbrush and a Brush Up mounted laptop computer. The machine had Bluetooth connectivity to the toothbrush and Internet connectivity to the testing servers, thereby allowing the team to remotely capture and track toothbrushing. Caregivers were given instructions on setting up the game at home, and were instructed to have the child play for seven consecutive nights (once / night) each evening. During the analysis, caregivers were specifically asked not to provide any advice on toothbrushing.**

**Results:**

**For the 34 children examined after seven days of game play, the mean age was 73.7 months (standard deviation: 6.6 months), 29.4% were female, 47.1% were white, 5.9% is Latino, and 85.3% were right-handed. Demographics of kids measured at 14 days and one year were identical.**

**After seven days, there were significant improvements in the main outcome measure in which the mean total toothbrushing time increased by 23.1±31.5 seconds (95% confidence interval [CI]: 12.2, 34.1; P<0.001) (Table 1). Toothbrushing distribution improved, with significant increases on lingual, maxillary occlusal, and posterior buccal surfaces. The largest increase was observed for lingual surfaces from a baseline mean of 0.9 seconds to a mean of 13.2 seconds (average increase=12.3 seconds; 95% CI: 7.4, 17.3). At baseline only 14.7% (5/34) of the children had any brushing of the lingual surfaces as compared to 76.5% (26/34) of the children who brushed lingual surfaces after seven days (McNema**

**Table?**

**Exploring Hyposthesis**

**The mean total toothbrushing time increased by 69.0±51.2 seconds (95 percent CI: 40.7, 97.3; P<0.001) for the subset of children who played the game for an additional seven days (n=15 years). After 14 days toothbrushing time increased considerably on all surface forms. The largest increase was found for the lingual surfaces, close to the seven-day findings (average increase=35.1 seconds; 95 percent CI:22.8, 47.3). At baseline only 26.7% (4/15) of the children had any brushing of the lingual surfaces as compared to 93.3% (14/15) after 14 days (McNemar's test; P=0.006).**

**The time variations and distribution shifts found after seven days and 14 days after one year without game play were not statistically significant(Table 2). There have been developments, though, which have not achieved statistical significance but which could be clinically meaningful. For comparison, in the group of children with 14 days of game play, the mean total time increased by 15.1 seconds (P=0.41) relative to the average, and the mean time for lingual surfaces increased by 9.5 seconds (P=0.18). Just 20.0 percent (2/10) rubbed the lingual surfaces at baseline, compared with 60 percent (6/10) of children after a year (McNemar's test; P=0.13).**

**Conclusion:**

**We evaluated whether a toothbrushing app in children ages 5–6 could improve the quality of toothbrushing. Our data show significant improvements in the time and delivery of the toothbrushing for children who used Brush Up for seven days. Further improvements were observed for a subset of children who used Brush Up for 14 days. In the absence of continued app use, few improvements noted after seven and 14 days appeared to persist after one year. Collectively, these findings suggest that health apps are a promising strategy**

 **to improve toothbrushing behaviors in children, but that continual use may be needed to optimize improvements. There are no published studies we can equate our results explicitly to. Numerous non-dentistry research, however, have shown changes in dental behaviors associated with apps.18–19 Average toothbrushing time rose by more than 50 percent after seven days and almost doubled after 14 days of product usage (Table 1). Both changes are clinically significant in light of the high average toothbrushing period (46.2 and 39.9 seconds respectively). In fact, major improvements have been made to the toothbrushing of previously overlooked teeth surfaces, including the lingual and maxillary occlusal surfaces, which are difficult areas for young children to clean.**

**Mechanism insight on how to enhance toothbrushing habits in applications like Brush Up is important knowledge that could be used for potential app-based treatments. For starters, gains in toothbrushing were better for kids who were using the app for 14 days compared to seven days. This indicates that greater gains may be associated with longer device use, but the optimum drug dosage is unclear. A related issue is the duration of the session on toothbrushing The Brush Up album had lasted three minutes at the time of the analysis. Similar results could have been obtained with a two-minute song, a reduction which would reduce the burden on the participants. Furthermore, over time the repetitiveness of health apps can contribute to user fatigue. This is, however, a positive feature for demographic subgroups for whom habits are significant, including persons with autism spectrum disorders.6,20 Post-intervention interviews with families and end-users with children may help elucidate ways to optimize, improve and customize app-based strategies.**

**There were three key drawbacks of the study: 1) the small sample size; 2) the study was not a randomized clinical trial; and 3) no patient impact measurement. The small sample can explain why, in one year, we struggled to see statistically significant differences. Our research results are expected to guide sample size estimates for potential initiatives and ensure a randomized clinical trial with sufficient resources. Such a study would need to put in place approaches that would require adequate follow-up of participants to determine to what degree, through app-based measures, longer-term behaviour change is possible. Participant rewards and e-incentives incorporated into the app will help to maintain particulate matter The third constraint could be addressed by including measurements of oral health effects in the short and long term to determine how toothbrushing with mobile games would prevent disease and improve oral health. Recognizing the value of adult supervision during toothbrushing, ensuring that an appropriate amount of fluoridated toothpaste is used, and tracking proper brushing, is crucial. We also understand that caries is a multifactorial disease in which factors outside toothbrushing are important in disease prevention, such as reducing added sugar consumption and using dental care.**

**To conclude, Toothbrushing games in terms of total brushing time and delivery will theoretically improve the quality of the toothbrushing in children.**

**Interventions must be designed to achieve sustainable, long-term changes in toothbrushing and oral health.**

**Future research will continue to evaluate mobile games in disadvantaged child communities as part of intervention strategies to strengthen oral health habits and outcomes.**