

**EVALUATION OF A NEWLY CREATED  
ORAL HEALTH EDUCATION MOBILE APPLICATION  
FOR ALTERING THE FREQUENCY AND DURATION  
OF TOOTH BRUSHING IN IMPROVING  
ORAL HYGIENE AND PLAQUE STATUS OF  
PRIMARY SCHOOL GOING CHILDREN –  
A RANDOMIZED CONTROLLED TRIAL**

*A Dissertation submitted in  
partial fulfilment of the requirements  
for the degree of*

**MASTER OF DENTAL SURGERY**

**BRANCH - VII**

**PUBLIC HEALTH DENTISTRY**



**THE TAMILNADU DR. M. G. R. MEDICAL UNIVERSITY**

**CHENNAI – 600 032**

**2017-2020**

# CERTIFICATE



This is to certify that this dissertation submitted by **Dr.S.Rajeshwari** (2017 - 2020 Batch), Post graduate student, Department of Public Health Dentistry, titled “**Evaluation of a newly created Oral health education mobile application for altering the frequency and duration of tooth brushing in improving Oral hygiene and plaque status of primary school going children – A Randomized controlled trial**” was carried out under my guidance in partial fulfilment of the regulations laid down by **The Tamil Nadu Dr. M.G.R. Medical University, Chennai** for M.D.S in **Public Health Dentistry** (Branch VII) degree examination.

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I, Dr. S.Rajeshwari, do hereby declare that the dissertation titled “**Evaluation of a newly created Oral health education mobile application for altering the frequency and duration of tooth brushing in improving Oral hygiene and plaque status of primary school going children – A Randomized controlled trial**” was done in the department of Public Health Dentistry, Tamil Nadu Government Dental College and Hospital, Chennai-600003. I have utilized the facilities provided in the Tamil Nadu Government Dental College and Hospital for the study in partial fulfilment of the requirements for the degree of Master of Dental Surgery in the specialty of Public Health Dentistry (Branch VII) during the course period 2017-2020 under the conceptualization in guidance of the dissertation guide **Dr. S. G. Ramesh Kumar, M.D.S.,**

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and

**Dr. S. G. Ramesh Kumar, M.D.S.**, aged 39 years working as Reader, Department of Public Health Dentistry at the college, having residence address at Plot No: 15, 7<sup>th</sup> street, Balaji Nagar, Alwarthirunagar, Chennai-600 087 (herein after referred to as the ‘Researcher and Principal investigator’)

and

**Dr. S.Rajeshwari**, aged 27 years currently studying as Post Graduate student in the Department of Public Health Dentistry (herein after referred to as the ‘PG/Research student and Co- investigator’).

Whereas the ‘PG/Research student as part of her curriculum undertakes to research on the study titled **“Evaluation of a newly created Oral health education mobile application for altering the frequency and duration of tooth brushing in improving Oral hygiene and plaque status of primary school going children – A Randomized controlled trial”** for which purpose the Researcher and Principal investigator shall act as Principal investigator and the College shall provide the requisite infrastructure based on availability and also provide facility to the PG/Research student as to the extent possible as a Co-investigator.

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**“To succeed in your Mission,  
You must have single-minded devotion to your Goal”**

*-Dr.A.P.J.Abdul Kalam*

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## ABSTRACT

**Introduction:** Oral health is an essential component of a person's health. According to World Health Organization (WHO), about 60 percent to 90 percent of children and nearly every adult in the world have Dental caries. The most important risk factors for caries are associated with attitudes and behaviours. Strategies to control Dental caries include effective oral hygiene practices. Children's manual skills are very poor as well as the motivation to oral hygiene and often parents are forced to take part in the oral hygiene practices. At present days, however, technology is largely used in improving motivation and compliance in health management and in oral health and it might be a point to take into account also for improvement of children engagement and compliance maintenance. Several apps and tools are specifically developed for training and teaching children and often avoiding need to have proper training to approach them. In Dentistry, technologies to educate and motivate in oral health maintenance are broadly available. Therefore, the aim of this study was to evaluate the newly created Oral health education mobile application for altering the frequency and duration of tooth brushing in improving Oral hygiene and plaque status of primary school going children.

**Materials and Methods:** Eighty study participants were randomly recruited and allocated into one of the two intervention groups. Details about participant's Oral hygiene practices which includes frequency, duration and method of brushing were noted and their baseline Simplified Oral hygiene index and Plaque index scores were recorded. Chair-side Oral hygiene instructions were given to the participants in the control group and the mobile application (**Nam vaai**) along with the Oral hygiene instructions were given to the participants in the study group. The participants were followed up for a period of 21 days and details about their Oral hygiene practices and Simplified Oral hygiene index and Plaque index scores were recorded at the end of 21 days.

**Results:** The study showed that Oral hygiene behaviours such as frequency of brushing, duration of brushing and method of brushing has significantly improved in both study group and the control group but the percentage of participants who changed their Oral hygiene behaviour was higher in study group compared to control group which is statistically significant ( $P<0.05$ ).

There was a statistically significant change in the Simplified Oral hygiene index and Plaque index scores in both groups before and after the intervention and it was statistically significant ( $P<0.05$ ). Intergroup comparison showed that the reduction in the Simplified Oral hygiene index and Plaque index scores was better in the study group compared to the control group and this difference was statistically significant ( $P<0.05$ ). It was also found that the frequency of brushing and duration of brushing were moderately correlated with the Simplified Oral hygiene index and Plaque index and it is statistically significant ( $P<0.05$ ).

**Conclusions:** There is a statistically significant difference in the effect of time, frequency and duration of brushing on Oral hygiene and plaque status of primary school going children between the study and the control group. Hence, mobile application can be used as a promising tool to motivate an evidence-based oral hygiene practices.

**Key Words:** *Mobile application, Oral hygiene, tooth brushing, dental plaque.*

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## LIST OF ABBREVIATIONS

CG	Control group
CI	Confidence interval
CI-S	Simplified calculus index
DI-S	Simplified debris index
ECC	Early Childhood Caries
GI	Gingival index
GRADE	Grading of Recommendations, Assessment, Development and Evaluations
IBM	The International Business Machines Corporation
IRB	Institutional review board
MAR	Mobile application reminder
NY	NewYork
OHI-S	Simplified Oral hygiene index
PI	Plaque index
SG	Study group
SMS	Short Message Service
SPSS	Statistical Package for the Social Sciences
TNGDC&H	Tamil Nadu Government Dental College and Hospital
TPB	Theory of Planned Behaviour
U.S.	United States
WHO	World Health Organization



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## **INTRODUCTION**

Mobile devices are a useful means to deliver health interventions because of their wide-spread adoption, powerful technical capabilities and portability. People tend to have their mobile phones on them at most times and form strong emotional attachments to them. ‘Sick or well, we have come to love our mobile devices. They are a source of immediate gratification: a powerful link to those we love, access to pictures, sports scores, movies and conversation with friends and relatives. That little device is so positive, so beloved. It connects us to the world.’<sup>(1)</sup>

A mobile phone is a multipurpose and powerful device capable of performing a number of tasks that are beyond its primary purpose of communication. Mobile apps are software programmes that run on smartphones and other mobile devices. With over 2.7 billion smartphone users across the world, it’s no surprise that the mobile app industry is thriving. There are 2.8 million apps available for download on the Google Play Store and 2.2 million apps available for download from Apple App store<sup>(2)</sup>.

In 2018, globally there were more than 205 billion app downloads. That’s a 15% increase from the year 2017. The Google Play Store downloads grew by 14%, while the Apple App Store had just a 3% growth rate. Experts predict that there will be a 25% increase in global app downloads between 2018 and 2022. Global statistics states that the average smartphone owner uses 30 apps each month and 49% of people open an app 11+ times each day. The average smartphone user spends 2 hours and 15 minutes each day using apps and 10% of people check their phones once every four minutes. Japan and China have the highest average number of apps installed on smartphones. However, the percentage of apps being used isn’t nearly as high. India has the second lowest number of apps installed per device. However, it has the highest number of apps used per month, demonstrating a higher usage ratio. Thus, if a person in India

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downloads an app, there is a greater chance that they will use it, at least on a monthly basis. In India, the average smartphone users use 11 apps per day and spends an average of 160 minutes per day<sup>(3)</sup>.

Technology usage varies with generations. Mobile app usage is no exception. In 2011, it is common to see children carrying mobile phones in many countries in the world. The age of those able to use these devices is decreasing reporting that six-year-olds understand digital technology better than adults<sup>(4)</sup>.

Mobile technology is making huge inroads even in the healthcare space. Mobile technology has the potential to impact every aspect of our lives, including health and wellness. The US Food and Drug Administration states: ‘The widespread adoption and use of mobile technologies is opening new and innovative ways to improve health and healthcare delivery. Apps can help people manage their own health and wellness, promote healthy living and gain access to useful information when and where they need it.

mHealth (or mobile health) is commonly defined as the provision of health services through mobile technologies. mHealth is about leveraging mobile and wireless devices to improve health outcomes. The service could be as simple as using the mobile’s SMS function to send alerts and reminders or leveraging inbuilt mobile sensors or apps to capture and interpret clinical data. In India, there is considerable potential to leverage mHealth as an alternative healthcare delivery channel. Structural, financial and behavioural factors have created a significant need for such a channel. According to data gathered from Google Trends, India ranks among the top five countries for search terms like ‘mobile health’, ‘health apps’, ‘medical apps’ and ‘mHealth’ which signifies that the Indian population is interested in mHealth<sup>(5)</sup>.

The success of a mobile app is based on its penetration. According to global Statistics, the health related apps has a penetration rate of 23% and lifestyle related apps has a penetration

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rate of 65%. A survey carried out among patients in 2012 found 59% of respondents indicated that mobile health apps would change the way health information is sought and 50% felt that these apps will radically change the way they manage their chronic disease. Thus, Health apps have been developed to manage various common medical conditions such as diabetes, asthma, pain and dermatological conditions and Oral health promotion as well.

Poor oral health can affect someone's ability to eat, speak, smile and socialise normally, due to pain or social embarrassment. About 90% of school children world-wide and most adults have experienced caries, with the disease being most prevalent in Asian and Latin American countries. These could be attributed to several factors mainly lack of oral health awareness and over consumption of refined carbohydrate. Children who suffer from poor oral health are 12 times more likely to have restricted-activity days than those who do not. More than 50 million school hours are lost annually due to oral health problems, which affect children's performance at school and success in later life<sup>(6)</sup>.

The most widespread Dental plaque control method at home is tooth brushing, along with other mechanical cleansing procedures, and motivation to maintain good oral health at appropriate intervals. Studies show that verbal instructions of oral hygiene alone are insufficient to provide significant changes in Dental plaque control, which can be achieved more successfully when these instructions are accompanied by written and visual illustrations<sup>(7)</sup>. Adherence by patients is an essential part of oral hygiene, and technologies, such as notifications of mobile applications/ SMS messages, can be used to significantly increase patient compliance, and thereby decrease plaque build-up and gingival inflammation<sup>(8)</sup>. Compared to traditional approaches, interactive multimedia approaches and visually attractive materials are more appropriate for communicating and motivating patients<sup>(9)</sup>.



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Evidence is also available that a significant percentage of the population do not accomplish these daily tasks, with 33% of men brushing less than twice a day and 59% of women regularly skipping brushing at bedtime.

The oral hygiene habits of a study conducted by Meenakshi et al indicated that 58.30% of the children would brush their teeth twice per day, whereas 36.10% would brush only once per day. It was seen that 98% of the children used tooth brush and tooth paste to clean their teeth, while most subjects about 90% preferred to brush in the morning. About 45.30% of the subjects brushed their teeth for more than 2 min, while 41.90% brushed for at least 2 min<sup>(10)</sup>.

It seems that the children are not aware of the duration of brushing, frequency of brushing the teeth per day, and the method of cleaning the teeth. Mobile apps can be used to positively influence the children and improve their oral hygiene practices<sup>(11)</sup>. Oral health apps can be recommended to patients and as a public health measure to improve the oral health of the population. A literature review found that there are limited research currently investigating the use of a mobile app to motivate evidence-based oral hygiene behaviour. Therefore, the present study was planned with an aim to evaluate the effect of time, frequency and duration of brushing on Oral hygiene and plaque status of primary school going children by creating a standardized mobile application.

**RESEARCH HYPOTHESIS:**

There is a significant difference in the reduction of plaque formation and improvement in the oral hygiene on usage of mobile application between the study group and control group.

**NULL HYPOTHESIS:**

There is no significant difference in the reduction of plaque formation and improvement in the oral hygiene on usage of mobile application between the study group and control group.

## **AIM AND OBJECTIVES**

### **AIM:**

The aim of the present study is to evaluate the newly created Oral health education mobile application for altering the frequency and duration of tooth brushing in improving Oral hygiene and plaque status of primary school going children.

### **OBJECTIVES:**

The objectives of the study are:

1. To create a standardized mobile application to improve the Oral hygiene practices among children.
2. To evaluate the clinical improvement in Oral hygiene of the children in the study group and control group using
  - a. Simplified Oral hygiene Index (John C. Green and Jack R. Vermillion, 1964)
  - b. Plaque Index (Silness J and Loe H, 1964)
3. To evaluate the improvement in the Oral hygiene practices in terms of time, frequency and duration of tooth brushing.
4. To compare the Oral hygiene practices and Oral hygiene status with age, gender and socioeconomic status.

## **REVIEW OF LITERATURE**

Using a mobile platform for oral health promotion provides the opportunity to engage parents, enable communication, and potentially help overcome oral health challenges for the management of oral diseases. Although Dental apps for children are available from a variety of sources, there are only limited literature suggesting that the apps were developed in a research setting.

*B. Underwood et al, 2015*, conducted a study to assess user perception of an oral health app to give a basis for future research and development of app technology in relation to oral health. A cross-sectional qualitative user perception questionnaire was developed and administered. One hundred and eighty-nine people responded to the questionnaire. Seventy percent (n = 113) of respondents reported that their teeth felt cleaner since using the app. Eighty-eight percent (n = 133) reported the app motivated them to brush their teeth for longer and 92.3% (n = 144) would recommend the app to their friends and family. Four broad themes relating to how the app helped tooth brushing were reported. These themes were motivation, education, compliance and perceived benefits. This study concluded that a mobile app is a promising tool to motivate an evidence-based oral hygiene routine.<sup>(12)</sup>

*Francesca Zotti et al, 2016*, conducted a study to test effectiveness of apps in improving oral hygiene in children patients aged from 4 to 7 years and evaluating correlation between parent's educational attainment and children oral hygiene. 100 patients aged from 4 to 7 years were randomly assigned by an external office in the study group (SG: 32 females, 18 males) and in the control group (CG: 28 females and 22 males). Plaque index (PI) and carious lesions localisation were detected. At baseline all patients and one of the parents were instructed at

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chair-side about the proper oral hygiene techniques. SG patients were also given app as an aid in oral hygiene practice. Follow-up was 12 months. Measurements were made every three months at chair-side visits. Information about children compliance in oral hygiene and educational level of parents were obtained by questionnaires at t0 and after 12 months. Results showed that SG patients showed stronger oral hygiene and PI lower than those in CG. Questionnaire showed higher compliance of SG patients and parent's educational level seemed to affect children oral hygiene. Thus they concluded that apps in children allowed achieving encouraging results with improvement of oral hygiene and health.<sup>(13)</sup>

**Alkadhi OH et al, 2017**, conducted a randomized clinical trial to determine the extent to which mobile application reminders (MAR) improve OH compared with conventional oral OH instructions in patients undergoing orthodontic treatment with fixed appliances. They enrolled 44 participants and assigned them to receive MAR 3 times a day or oral OH during routine orthodontic treatment visits. Participants who received MAR had an average reduction of 0.14 points on the plaque index (PI) and 0.12 points on the gingival index (GI) after 4 weeks, whereas participants who received oral OH instructions had an average increase of 0.10 points on the PI and no differences on the GI after 4 weeks. The PI was 0.32 points lower and the GI was 0.37 points lower in participants who received MAR than in those who received oral OH instructions. § Strengths and limitations. This randomized clinical trial had a low risk of bias. The researchers assigned participants to received MAR or oral OH instructions using appropriate methods. Although the participants could not be blinded owing to the nature of the intervention, the study's outcome assessors, data collectors, and data analysers did not know to which group each participant belonged, which decreased the risk of bias. Finally, there seem to have been no participants lost to follow-up. The researchers made sure that the outcome assessors were trained and highly calibrated, which increases our confidence in the results. The

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authors of this study explored an intervention that is likely to be widely accepted by most patients undergoing orthodontic treatment using fixed appliances. Unfortunately, there are few details about the eligibility criteria for enrolling participants in the study, such as OH habits and caries and periodontal disease histories, which makes it difficult to judge the extent of the applicability of these results to other settings. In addition, the researchers measured PI and GI after only 4 weeks. Even though this is enough time for MAR to have an effect on the outcomes, it is too short to infer whether there would be a long-term benefit of MAR in outcomes that are more important to patients, such as lack of white-spot lesions and caries. Finally, the differences in GI between the groups were small and unlikely to be important to patients.<sup>(14)</sup>

*Janneke F. M. Scheerman et al, 2018*, conducted a study to evaluate the effectiveness of the White Teeth mobile app, a theory based mobile health (mHealth) program for promoting oral hygiene in adolescent orthodontic patients. In this parallel randomized controlled trial, the data of 132 adolescents were collected during three orthodontic check-ups: at baseline (T0), at 6-week follow-up (T1) and at 12-week follow-up (T2). The intervention group was given access to the White Teeth app in addition to usual care (n = 67). The control group received usual care only (n = 65). The oral hygiene outcomes were the presence and the amount of Dental plaque (Al-Anezi and Harradine plaque index), and the total number of sites with gingival bleeding (Bleeding on Marginal Probing Index). Oral health behaviour and its psychosocial factors were measured through a digital questionnaire. They performed linear mixed-model analyses to determine the intervention effects. Results showed that at 6-week follow-up, the intervention led to a significant decrease in gingival bleeding (B = -3.74; 95% CI -6.84 to -0.65) and an increase in the use of fluoride mouth rinse (B = 1.93; 95% CI 0.36 to 3.50). At 12-week follow-up, Dental plaque accumulation (B = -11.32; 95% CI -20.57 to -2.07) and the number of sites covered with plaque (B = -6.77; 95% CI -11.67 to -1.87) had

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been reduced significantly more in the intervention group than in the control group. The results showed that adolescents with fixed orthodontic appliances can be helped to improve their oral hygiene when usual care is combined with a mobile app that provides oral health education and automatic coaching. <sup>(15)</sup>

*Courtney E. Bohn et al, 2018*, conducted a study to assess perceptions and preferences regarding the use of apps in Dental settings. Four patient education apps describing fixed partial dentures were demonstrated to participants (N = 25). Questions about each app were asked using a semi-structured interview format to assess participants' opinions about each app's content, images, features, and use. Sessions were analysed via note-based methods for thematic coding. Participants believed that apps should be used in conjunction with a Dental Surgeon's explanation about a procedure. They desired an app that could be tailored for scope of content. Participants favoured aesthetic images of teeth that did not show structural anatomy, such as tooth roots, and preferred interactive features. Conclusions: Patient education apps may be a valuable tool to enhance patient provider communication in Dental settings. Participants exhibited varying preferences for different features among the apps and expressed the desire for an app that could be personalized to each patient. Additional research is needed to assess whether the use of apps improves oral health literacy and informed consent among patients. <sup>(16)</sup>

*Sara L Nolen, RDH, MS et al, 2018*, conducted a study to develop and test a smartphone application (app) prototype, Tooth Sense, as an oral health promotion tool for the prevention of Early Childhood Caries (ECC) based on the Theory of Planned Behaviour (TPB). A quantitative and qualitative design process based on the TPB was used for the app development in the first phase of the study. A behavioural intervention technologic model was used to document the app features design, accounting for Doshi's intervention strategies for the TPB.

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Beta-testing of the app was hosted via an online software program. Testers were presented with a series of tasks and prompts followed by a 5-point Likert-scale questionnaire that quantitatively measured perceptions of the app's interactive design based on Jakob Nielsen's principles and behavioural strategies. A Net Promoter Score was calculated to determine the tester's likelihood to recommend the app prototype. Audio and video aspects of the app were qualitatively measured using a template approach. Results showed that Beta testers agreed the app met the majority of the five usability statements. The Net Promoter Score indicated a likelihood to recommend the app prototype. Thematic analyses revealed the following themes: interface design, navigation, terminology, information, and oral health promotion. Beta testing results from this study provided health promotion project design information for the prevention of ECC using the TPB and highlighted the importance and usability of smartphone app for oral health promotion. <sup>(17)</sup>

*Alaa Ahmad Alqarni et al, 2018*, conducted a study to develop a mobile-based application and assess its efficacy in improving child Dental health knowledge of parents. A mobile-based application (Your child's smile) was developed and made available on application-store and play store. This application provided all essential information to parents on child Dental health prepartum and from infancy to adolescence. To assess improvement in parent's knowledge two similar pretested questionnaires were incorporated within the application, one to be filled at initial registration and other after the parents had utilized the application. Responses were entered into MS excel sheet and analysed using IBM SPSS statistics version 20.0. Results showed that within the 15 days' research period, the application was downloaded by 230 parents out of whom 110 answered only the 1st and 120 both questionnaires. Out of the 120 who responded to both majority showed highly significant ( $P < 0.01$ ) or significant ( $P < 0.05$ ) improvement in their knowledge on tooth development,



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importance of deciduous teeth, importance of regular Dental check-up, pit and fissure sealants, bedtime bottle use, and consequence of early loss of deciduous teeth. Confidence in child Dental health knowledge was also evident in other areas with more parents opting for agreeing, strongly agree, or disagree options. A majority 75% of parents favoured the use of mobile applications as an effective child Dental health knowledge tool. This study concluded that mobile based applications are an effective tool for providing child oral health knowledge to parents and significant improvement in knowledge is evident after parents utilized the mobile-based application.<sup>(18)</sup>

*Luciana F.X.A. Campos, MS et al, 2019*, conducted a study by developing an educational game in application format for mobile devices and tested its usability. Forty-three children were randomly selected to participate in the study. The methodology used in the development of the application was based on an interactive children's book flux design. The application was elaborated for the Android and iOS platforms. To evaluate usability, a test method composed of observation and interview surveying was used, and the measuring mechanism consisted of the User's Success Rate. The sample (N= 43) was randomly composed of preschool students (3–5 years of age) from a public school in Brazil. Results showed that in the effectiveness tests, the success rates of the Story and Game Menus were 97.6% and 85.3%, respectively. In the efficiency tests, the respective rates were 80.2% and 82.1%. The satisfaction evaluation rate was 99.7%. Discussion: The game "Put the healthy food into the mouth" showed to be difficult in utilization due to the children's lack of knowledge concerning healthy foods ( $p < 0.001$  and 95% confidence interval). Three year olds demonstrated a greater requirement for assistance during navigation. The study concluded that the application was successful regarding the following three assessed attributes: effectiveness, efficiency, and

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satisfaction. However, dietary education was observed to be necessary for the children and their guardians.<sup>(19)</sup>

*Mirian P. Toniazzo et al, 2019*, conducted a study to evaluate the effectiveness of mobile applications and text messages, compared with conventional oral hygiene instructions, for improving oral health knowledge and/or reducing gingival inflammation, when delivered to adolescents, adults and mothers of young children. A search was performed in the Medline-PubMed, Scopus and Embase databases and the grey literature. The eligible studies comprised those related to plaque, gingival bleeding and/or oral health knowledge as outcomes. The risk of bias was assessed with the Cochrane tool and the GRADE system. Two meta-analyses were carried out. Among the fifteen studies selected, twelve (80%) used text messages and thirteen (87%) showed better results when mobile technology was used. The pooled SMD for the Dental plaque index (n = 10 studies) was -9.43 (95% CI -14.36 to -4.495; I2 = 99%, p < 0.001), and that of gingival bleeding (n = 7 studies) was -8.54 (95% CI -13.16 to -3.91; I2 = 99%, p < 0.001), indicating significant improvement in Dental plaque control and gingival bleeding for groups that received the mobile health (mHealth) strategy. The author concluded that mHealth can be used as an adjunct component in managing gingivitis, acquiring oral health knowledge and improving oral hygiene.<sup>(20)</sup>

## **MATERIALS AND METHODS**

### **ETHICAL CLEARANCE**

The study proposal was submitted for approval and clearance to the Institutional Review Board of Tamil Nadu Government Dental College and Hospital, Chennai (IRB Reference number: 7/IRB/2007). The Institutional Review Board clearance certificate so obtained is enclosed in the Annexure.

### **CLINICAL TRIAL REGISTRATION**

The study was registered in the Clinical trial Registry of India and the CTRI number is REF/2019/029525.

### **APPROVAL FROM AUTHORITIES**

Permission to conduct the study was obtained from the concerned authorities of Department of Pedodontics and Preventive Dentistry, Tamil Nadu Government Dental College and Hospital, Chennai. The permission letter so obtained is enclosed in the Annexure.

### **SAMPLE SIZE DETERMINATION**

The sample size was determined using G-Power software.

**Means:** Wilcoxon-Mann-Whitney test (two groups)

**Analysis:** A priori: Compute required sample size

#### **Input:**

Tail(s) = Two

Parent distribution = Normal

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Effect size d	=	1.1362370
$\alpha$ err prob	=	0.05
Power (1- $\beta$ err prob)	=	0.99
Allocation ratio N2/N1	=	1

**Output:**

Noncentrality parameter $\delta$	=	4.3713992
Critical t	=	2.0023095
Df	=	57.2056388
Sample size group 1	=	31
Sample size group 2	=	31
Total sample size	=	62
Actual power	=	0.9902794

Thus, the final sample for the study was decided to be a minimum of 62 subjects, each group having a minimum of 31 subjects. However, the sample size was increased to 40 per group, after making an adjustment for drop-outs.

**PREPARATION OF CASE SHEET FORM**

A specially prepared format in English language exclusively designed for recording all relevant data pertaining to demographic information, Oral hygiene practices and Oral hygiene status was used. A copy of the format is enclosed in the Page number: 25

## **TRAINING AND CALIBRATION FOR RECORDING ORAL HYGIENE STATUS**

A training and calibration session was carried out to check the intra-examiner variability for recording the Oral hygiene status. After the training session Kappa statistic was calculated for intra-examiner reliability and it was found to be 0.83 which indicates high degree of reliability and consistency in judgment.

## **STUDY DESIGN**

A concurrent parallel, randomized controlled trial was conducted to evaluate the effect of time, frequency and duration of tooth brushing on Oral hygiene and plaque status of primary school going children by creating a standardized mobile application at Tamil Nadu Government Dental College and Hospital, Chennai. A 1:1 allocation ratio was maintained throughout the study.

## **STUDY PARTICIPANTS**

The study participants comprised of eighty primary school going children attending the Tamil Nadu Government Dental College and Hospital, Chennai.

## **ELIGIBILITY CRITERIA**

### **Inclusion criteria**

1. Children aged 7 to 12 years with at least one completely erupted permanent incisor and permanent molar
2. Children whose parents have Android mobile phones

### **Exclusion criteria**

1. Children who underwent Oral prophylaxis within past one month

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2. Physically and mentally challenged children
  3. Medically compromised children
  4. Children on long-term medication
  5. Children under the treatment of preventive or interceptive Orthodontics.

## **STUDY SETTING AND LOCATION**

The study was conducted at Department of Public Health Dentistry and Department of Pedodontics and Preventive Dentistry, Tamil Nadu Government Dental College and Hospital, Chennai.

## **INFORMED CONSENT**

Written informed consent was obtained from parents of the selected participants of study and control group after explaining the purpose of the study. A copy of the informed consent is enclosed in the Page number: 32

## **RANDOMIZATION**

The children were randomly assigned to one of two intervention groups with 1:1 allocation ratio. Randomization was done by a computer-generated random numbers list. Each child was assigned a number using a random number sequence and received a corresponding intervention. The list of random sequence of numbers generated is enclosed in the Annexure.

## **INTERVENTIONS**

### **Intervention for the Study group**

A mobile application named “**Nam Vaai**” was developed consisting of features such as a stopwatch to monitor the duration of tooth brushing for 2 minutes, reminder feature which

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allowed the participant to set customised alarm in the morning and evening to remind tooth brushing, an Oral health guide which consisted of 14 videos to impart knowledge on general parts of Oral cavity, Dental caries, Periodontal disease, Malocclusion, Oral cancer, Dental fluorosis, Temporomandibular joint disorders and Dentofacial trauma. Videos to impart knowledge on mechanical plaque control measures and chemical plaque control measures were included in the app. A daily task was included in the app where the participants were asked to check-in in the morning and night after tooth brushing so as to make sure the frequency of tooth brushing daily and to check their compliance. The Mobile app was installed in the parent's mobile phone. Periodic reminders and reinforcements were provided through features inbuilt within the Mobile. The screenshots of the mobile application is enclosed in the Annexure.

### **Intervention for the Control group**

Conventional chair-side oral hygiene instructions were given by demonstrating the proper tooth brushing technique in a model. The importance of maintaining a good oral hygiene, the risk factors and the management of common oral diseases were emphasized to the participants. Periodic reminders and reinforcements were given for the participants through telephonic calls once in a week.

### **PERIOD OF RECRUITMENT**

The period of recruitment was from November 2019 to December 2019.

### **DATA COLLECTION**

The case record form was used to record the following data.

- 1.Sociodemographic data
- 2.Details regarding Oral hygiene practices

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3.Simplified Oral hygiene Index (John C. Green and Jack R.Vermillion, 1964)

4.Plaque Index (Silness J and Loe H, 1964)

### **Armamentarium**

The following instruments were used during screening and clinical examination of the participants.

1. Disposable Face masks
2. Disposable Gloves
3. Mouth Mirror
4. Dental Explorer
5. William's Periodontal Probe
6. Cotton holder
7. Copies of case record form
8. Rectangular stainless-steel tray
9. Sterile cotton swab
10. Toothbrush and toothpaste
11. Android mobile application
12. Patient compliance sheet

Eighty participants satisfying the pre-defined eligibility criteria were recruited for the study. The participant's parents/guardians were clearly informed about the purpose of the study. Written informed consent was obtained from the selected participant's parents/guardians. Sociodemographic data, details about the Oral hygiene practices, baseline scores of Simplified Oral hygiene Index (John C. Green and Jack R.Vermillion, 1964) and Plaque Index (Silness J and Loe H, 1964) were recorded by the chief investigator. Random



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allocation of the participants was done to the study group and the control group. Participants of study group received Oral hygiene instructions along with the installation of the mobile application in their parent's mobile. The parents were instructed to allow their children to use the mobile application twice daily, once in the morning and once in the night before bedtime. The participants of the control group received Oral hygiene instructions and a participant compliance sheet. All the participants in both the groups were provided with a standard toothbrush and a toothpaste. The oral hygiene instructions were given by demonstrating the proper tooth brushing technique in a model. The importance of maintaining a good oral hygiene, the risk factors and the management of common oral diseases were emphasized. Periodic reminders and reinforcements were given for the participants through telephonic calls once in a week.

The participants were advised to visit the hospital at the end of the 21<sup>st</sup> day. To check the compliance of the participants, they were asked to bring their toothbrush at the follow-up visit to check for the fraying of the toothbrush bristles. The participants in the study group were asked to bring the mobile application at the end of 21<sup>st</sup> day to check the compliance. The mobile app was deleted during the follow-up visit due to avoid copyright issues. During the follow-up visit, oral hygiene practices, scores of Simplified Oral hygiene Index (John C. Green and Jack R. Vermillion, 1964) and Plaque Index (Silness J and Loe H, 1964) were again recorded by the calibrated chief investigator.

## **OUTCOMES**

The primary outcome measure used for this study were scores of Simplified Oral hygiene Index (John C. Green and Jack R. Vermillion, 1964) and Plaque Index (Silness J and Loe H, 1964). The scores were measured at baseline and at 21<sup>st</sup> day post intervention.

The Simplified Oral Hygiene Index is composed of the combined Debris Index-Simplified and Calculus index- Simplified, each of these index is in turn based on 6 numerical determinations representing the amount of debris or calculus found on the buccal and lingual surfaces of each of three segments of each Dental arch.

**Surfaces and teeth to be examined**

<b>TOOTH NUMBER</b>	<b>SURFACE</b>
16 – Upper right first molar	Buccal
11 –Upper right central incisor	Labial
26 – Upper left first molar	Buccal
36 – Lower left first molar	Lingual
31 –Lower left central incisor	Labial
46 –Lower right first molar	Lingual

At least two of the six possible tooth surfaces must have been examined.

**Scoring criteria for Debris Index- Simplified**

<b>SCORE</b>	<b>CRITERIA</b>
<b>0</b>	No debris or stain present
<b>1</b>	Soft debris covering not more than one third of the tooth surface, or presence of extrinsic stains without other debris regardless of surface area covered
<b>2</b>	Soft debris covering more than one third, but not more than two thirds, of the exposed tooth surface.
<b>3</b>	Soft debris covering more than two thirds of the exposed tooth surface.

Debris index- Simplified (DI-S) = Total debris score/No. of surfaces examined

**Scoring criteria for Calculus Index- Simplified**

<b>SCORE</b>	<b>CRITERIA</b>
<b>0</b>	No calculus present
<b>1</b>	Supragingival calculus covering not more than one third of the exposed tooth surface.
<b>2</b>	Supragingival calculus covering more than one third but not more than two thirds of the exposed tooth surface and/or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth.
<b>3</b>	Supragingival calculus covering more than two third of the exposed tooth surface and/or a continuous heavy band of subgingival calculus around the cervical portion of the tooth.

Calculus index- Simplified (CI-S) = Total calculus score/No. of surfaces examined

Oral hygiene index- Simplified = Debris index- Simplified + Calculus index- Simplified

**Interpretation:**

<b>FOR THE DI-S AND CI-S SCORE</b>	
Good	0.0 to 0.6
Fair	0.7 to 1.8
Poor	1.9 to 3.0

<b>FOR THE OHI-S SCORE</b>	
Good	0.0 to 1.2
Fair	1.3 to 3.0
Poor	3.1 to 6.0

The plaque index was examined for all teeth present at the time of investigation. Each of the four surfaces (disto-facial, facial, mesio-facial and lingual) of the index teeth was given a score from 0–3, called the PII score for the area. The scores from the four areas of each tooth were added and divided by four to give mean PII for the tooth. Finally, by adding the PII scores for all teeth and dividing it by number of teeth scored, the mean PII for the subject was obtained. The Plaque Index for the subject was thus an average score for the areas examined.

**Scoring criteria for Plaque Index**

<b>SCORE</b>	<b>CRITERIA</b>
<b>0</b>	No Plaque
<b>1</b>	A film of plaque adhering to the free gingival margin and adjacent area of the tooth. The plaque may be seen only by running a probe across the tooth surface.
<b>2</b>	Moderate accumulation of soft deposits within the gingival pocket, on the gingival margin and/or adjacent tooth surface, which can be seen by naked eye.
<b>3</b>	Abundance of soft matter within the gingival pocket and/or on the gingival margin and adjacent tooth surface.

### Interpretation of Plaque Index

Plaque scores	Condition
0	Excellent
0.1 – 0.9	Good
1.0 – 1.9	Fair
2.0 – 3.0	Poor

### STATISTICAL METHODS

The following statistical procedures were carried out in two steps.

1. Data compilation and presentation
2. Statistical analysis.

#### **Data compilation and presentation**

The obtained data was compiled systematically. A master table was prepared and the dataset was distributed meaningfully. The data was presented in percentages for categorical variables and in mean and standard deviation for continuous variables. The summarised data was presented as individual tables along with graphs.

#### **Statistical analysis.**

Statistical analysis was done using Statistical Package for Social Sciences (IBM SPSS Statistics for Windows, Version 22.0, Armonk, NY: IBM Corp. Released 2013). Depending upon the nature of the data appropriate statistical test were done as follows.

1. Descriptive analysis of sociodemographic data done
2. Shapiro Wilk's test was done to check the normality of data
3. Comparison of frequency, duration and method of brushing were done between study and control group using chi-square test.

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4. Intra group comparison of Simplified Oral hygiene index and Plaque index scores were done using Wilcoxon signed rank test.
  5. Inter group comparison of Simplified Oral hygiene index and Plaque index scores were done between study and control group using Mann-Whitney test.
  6. Spearman's Rho correlation was done to assess the correlation between frequency, duration and method of brushing and Simplified Oral hygiene index and Plaque index scores.

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## CASE RECORD FORM

**TITLE:**

**EVALUATION OF A NEWLY CREATED ORAL HEALTH EDUCATION MOBILE APPLICATION FOR ALTERING THE FREQUENCY AND DURATION OF TOOTH BRUSHING IN IMPROVING ORAL HYGIENE AND PLAQUE STATUS OF PRIMARY SCHOOL GOING CHILDREN – A RANDOMIZED CONTROLLED TRIAL.**

**Date :**

**Pin number :**

Name of the participant	Mr./ Ms./Mrs.			
Age	Years			
Sex	Male / Female			
Father's / Guardian's Name				
Mother's Name				
Date of birth				
Place of birth and nativity				
Religion	Hindu		Muslim	
	Jainism		Buddhism	
	Others, specify			
Education				
Occupation of the parent				
Income of parent				
Per capita Income				
Socioeconomic status	Score:	Class:		
Address with Pin code				
	Pin code:			
	Rural		Urban	
Phone number	Landline:	Mobile:		

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**PAST MEDICAL HISTORY** :

**PAST DENTAL HISTORY** :

**ORAL HYGIENE PRACTICES:**

1. Type of cleaning aid :
2. Material used :
3. Method of brushing :
4. Frequency of brushing :
5. Time & duration of brushing :
6. Frequency of changing tooth brush :

**INTRAORAL EXAMINATION**

**SIMPLIFIED ORAL HYGIENE INDEX (OHI-S)**

Authors and Year : John C. Green and Jack R. Vermillion in 1964.  
 Instruments Used : Mouth Mirror, No. 23 Explorer (Shepherd's Hook).

**Debris Index- Simplified (DI) :**

<b>16</b>	<b>11</b>	<b>26</b>		
				Score
				<div style="border: 1px solid black; width: 100px; height: 20px;"></div>
<b>46</b>	<b>31</b>	<b>36</b>		Good/Fair/Poor

**Calculus Index- Simplified (CI-S) :**

<b>16</b>	<b>11</b>	<b>26</b>		
				Score
				<div style="border: 1px solid black; width: 100px; height: 20px;"></div>
<b>46</b>	<b>31</b>	<b>36</b>		Good/Fair/Poor

**OHI-S = DI-S + CI-S**

**OHI-S SCORE =**

**INFERENCE = Good / Fair / Poor**

**PLAQUE INDEX**

Authors and Year

: Silness J. and Loe H in 1967.

Instruments Used

: Mouth Mirror, No. 23 Explorer (Shepherd's Hook) and Chip blower.

<b>17</b>	<b>16</b>	<b>15</b>	<b>14</b>	<b>13</b>	<b>12</b>	<b>11</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>	<b>25</b>	<b>26</b>	<b>27</b>
<b>47</b>	<b>46</b>	<b>45</b>	<b>44</b>	<b>43</b>	<b>42</b>	<b>41</b>	<b>31</b>	<b>32</b>	<b>33</b>	<b>34</b>	<b>35</b>	<b>36</b>	<b>37</b>

Score

**Inference:**

Excellent	0
Good	0.1 – 0.9
Fair	1.0 – 1.9
Poor	2.0 – 3.0

Excellent/Good/Fair/Poor



**PARTICIPANT INFORMATION SHEET**

**Investigator:** Dr. S.Rajeshwari

**Guide:** Dr.S.G.Ramesh Kumar, MDS.

III-year Post Graduate

Assistant Professor

Department of Public Health Dentistry

Department of Public Health Dentistry,

TNGDC&H

TNGDC&H

**Title:** Evaluation of a newly created Oral health education mobile application for altering the frequency and duration of tooth brushing in improving Oral hygiene and plaque status of primary school going children – A Randomized controlled trial.

The investigator, Dr.S.Rajeshwari under the guidance of Dr.S.G.Ramesh Kumar, MDS is conducting a study as titled above to find how the mobile applications can contribute to promotion of Oral health care through proper tooth brushing habits among primary school going children.

***1. The Procedure of the study***

The study participants and their parents are clearly informed about the purpose of the study. Written informed consent is obtained from their parents. Children aged 5 to 12 years are selected randomly for the study. Demographic data and their Oral health status is recorded from the participants through a case record form by the chief investigator. The study participants are provided with standard Oral hygiene instructions and a mobile application to improve their oral hygiene practices. Participants from control group are provided with standard Oral hygiene instructions. All participants are provided with a toothbrush and toothpaste. After 21 days of usage of mobile application, their oral health status is assessed again by using Oral hygiene index-Simplified (John C. Green and Jack. Vermillion, 1960), Plaque Index (Silness J. and Loe H, 1967) and Gingival Index (Loe H and Silness J, 1963) which is later analysed statistically for the clinical significance.

***2. Risks involved by the participants***

There are no risks in this study.

***3. Benefits of the participants***

By this study, the participants can be educated and motivated to practice standard oral hygiene practices which in turn improves their oral health status.

#### **4. Confidentiality**

The data collected from the participants are maintained confidential by the investigator.

#### **5. Voluntary participation**

Taking part in the study is voluntary. You are free to decide whether to participate in the study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled.

### **CONTACT DETAILS**

***Contacts details of The Principal investigator:***

Dr. S.Rajeshwari  
III Year Post Graduate,  
Department of Public Health Dentistry,  
Tamil Nadu Govt Dental College & Hospital,  
Phone number: 9384433303

**தகவல் தாள்**

வரிசை எண் :

**தமிழ்நாடு அரசு பல் மருத்துவக் கல்லூரி மற்றும் மருத்துவமனை-  
சென்னை 3  
சமுதாய பல் பாதுகாப்பு பிரிவு**

ஆராய்ச்சியாளர் : மரு. செ. ராஜேஸ்வரி

வழிகாட்டி: மரு.சு.கோ.ரமேஷ்குமார்

மரு. செ. ராஜேஸ்வரி ஆகிய நான், தமிழ்நாடு அரசு பல் மருத்துவக்கல்லூரி மற்றும் மருத்துவமனையில், சமுதாய பல் பாதுகாப்பு துறையில், மூன்றாம் வருடம் முதுகலைப் படிப்பு பயில்கிறேன். ஆய்வறிக்கையானது எனது பட்டப்படிப்பு பாடத்திட்டத்தின் ஒரு அங்கமாகும். எனவே “ஒரு முறையான மொபைல் பயன்பாட்டை உருவாக்குவதன் மூலம் முதன்மை பள்ளி செல்லும் குழந்தைகளின்பல் துலக்கும் நேரம்,கால அவகாசம், பயன்படுத்தும் எண்ணிக்கையை மதிப்பீடுதல்” என்கிற ஆய்வினை நான் செய்ய விரும்புகிறேன். இந்த வேலை அனைத்தும் எனது பேராசிரியர் மரு. .சு.கோ.ரமேஷ்குமார் MDS. அவர்களின் வழிகாட்டுதலின் கீழ் மேற்கொள்ளப்படும்.

**ஆய்வின் தலைப்பு:**

ஒரு முறையான மொபைல் பயன்பாட்டை உருவாக்குவதன் மூலம் முதன்மை பள்ளி செல்லும் குழந்தைகளின்பல் துலக்கும் நேரம்,கால அவகாசம், பயன்படுத்தும் எண்ணிக்கையை மதிப்பீடுதல்.

**ஆய்வின் தன்மை**

தற்போதைய ஆய்வின் நோக்கம் “ஒரு முறையான மொபைல் பயன்பாட்டை உருவாக்குவதன் மூலம் முதன்மை பள்ளி செல்லும் குழந்தைகளின் பல் துலக்கும் நேரம், கால அவகாசம், பயன்படுத்தும் எண்ணிக்கையை மதிப்பீடுதல்”.

**பங்கேற்பாளர்களின் செயல்முறை மற்றும் காலம்:**

தற்போதைய ஆய்வு நடத்த சம்பந்தப்பட்ட அதிகாரிகளிடமிருந்து அதிகாரப்பூர்வ அனுமதி பெற்றுள்ளது. ஆய்வு பங்கேற்பாளர்கள் மற்றும் அவர்களது பெற்றோர்கள் / காப்பாளர்கள் ஆகியோரிடம் ஆய்வுக்குரிய நோக்கம் பற்றி தெளிவாகத் தெரிவிக்கப்பட்டுள்ளது. பெற்றோரிடமிருந்து / சட்டப்பூர்வ பாதுகாவலர்களிடமிருந்து எழுதப்பட்ட ஒப்புதல் பெறப்பட்டது. மாணவர்கள் இரு குழுக்களாக தேர்வு செய்யப்பட்டு அதில் ஒரு குழுவினருக்கு வாய் சுகாதாரம் காக்கும் முறைகள் விளக்கப்பட்டது மற்றோரு குழுவினருக்கோ கூடுதலாக அலை பேசி மூலம் வாய் சுகாதாரம் காக்கும் முறைகளை விளக்கும் செயலி கொடுக்கப்பட்டது. அவற்றை இருபத்தி ஒரு நாட்கள் பயன்படுத்திய பின்னர் அவர்களின் வாய் சுகாதாரத்தை குறிக்கும் புள்ளி விவரங்கள் சேகரிக்கப்பட்டு ஆய்வு மேற்கொள்ளப்பட்டது

**அபாயங்கள்:**

இந்த ஆய்வில் பங்கேற்க பங்கேற்பாளர்களுக்கு நடைமுறை ஆபத்துகள் எதுவும் இல்லை

**நன்மைகள்:**

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இவ்வாறு அலைபேசியின் செயலி மூலம் பள்ளி மாணவர்களின் வாய் சுகாதாரம் மேம்படுத்தப்பட்டது என நிரூபிக்கப்பட்டால் அவற்றை ஆரோக்கிய கல்வி பயன்பாட்டிற்கு பயன்படுத்தலாம்

இரகசியத்தன்மை:

பங்கேற்பாளர்களிடமிருந்து சேகரிக்கப்பட்ட தரவு ஆராய்ச்சியாளரால் இரகசியமாக பராமரிக்கப்படுகிறது.

தன்னார்வ பங்களிப்பு:

ஆய்வில் பங்களிப்பது தன்னார்வம் கொண்டதாகும். ஆய்வில் பங்கேற்க வேண்டுமா அல்லது எப்போது வேண்டுமானாலும் திரும்பப் பெறலாமா என நீங்களே முடிவு செய்யலாம்; உங்கள் முடிவை நீங்கள் வேறு எந்த உரிமையினாலும் இழக்க நேரிடாது.

தொடர்பு விவரங்கள்

தலைமை ஆராய்ச்சியாளரின் தொடர்பு விவரங்கள்

மரு. செ. ராஜேஸ்வரி  
மூன்றாம் வருடம் முதுகலைப் படிப்பு,  
சமுதாய பல் பாதுகாப்பு பிரிவு,  
தமிழ்நாடு அரசு பல் மருத்துவக்கல்லூரி மற்றும் மருத்துவமனை,  
சென்னை, 600003.  
தொலைபேசி எண்: 9384433303

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TAMILNADU GOVT. DENTAL COLLEGE & HOSPITAL CHENNAI -3  
DEPARTMENT OF PUBLIC HEALTH DENTISTRY

S.NO:

Investigator: Dr.S.Rajeshwari      Guide: Dr. Dr.S.G.Ramesh Kumar, MDS

**INFORMED CONSENT FORM**

**Study title:** Evaluation of a newly created Oral health education mobile application for altering the frequency and duration of tooth brushing in improving Oral hygiene and plaque status of primary school going children – A Randomized controlled trial.

Name: Mr/Ms \_\_\_\_\_

Address: \_\_\_\_\_

SEX : Male /Female

AGE :      Years

I, \_\_\_\_\_, exercising my free power of choice, hereby give my consent to be included in the study.

I agree to the following:

1. I have been informed to my satisfaction about the purpose of the study and study procedures.
2. I agree to have a full mouth examination for the purpose of this research
3. I agree to co-operate fully for complete examination and I am informed that oral punch biopsy and photographs of the oral lesion will be taken during the study.
4. I have informed to the investigator about the details of the medications I had taken or being taken
5. I agree to revisit for the purpose of this research if needed in in the future
6. I understand that I have rights to withdraw from the study and also that the investigator has the right to exclude me from the research at any point of time.
7. I hereby give permission to use my medical records for research purpose. I am told that the investigating doctor and the institution will keep my identity confidential.
8. As I am unable to read and write the following points are read and explained to me very clearly

Name of Participant:

Signature/Thumb impression

Investigator :

Date:

தமிழ்நாடு அரசு பல் மருத்துவக் கல்லூரி மற்றும் மருத்துவமனை-சென்னை 3

சமுதாய பல் பாதுகாப்பு பிரிவு  
ஆராய்ச்சி ஒப்புதல் படிவம்

வரிசைஎண் :

ஆராய்ச்சியாளர்: மரு. செ. ராஜேஸ்வரி

வழிகாட்டி: மரு. ச. கோ. ரமேஷ்குமார்

**ஆராய்ச்சி தலைப்பு:**

ஒரு முறையான மொபைல் பயன்பாட்டை உருவாக்குவதன் மூலம் முதன்மை பள்ளி செல்லும் குழந்தைகளின்பல் துலக்கும் நேரம், கால அவகாசம், பயன்படுத்தும் எண்ணிக்கையை மதிப்பீடுதல்.

பெயர் திரு/திருமதி.....

புற நோயாளியின் எண் .....

முகவரி: .....

பாலினம்:ஆண்/ பெண்

.....

வயது:

.....

நான் ..... என்னுடைய சுயநினைவுடனும் மற்றும் முழுசுதந்திரத்துடனும் என்னை இம்மருத்துவ ஆராய்ச்சியில் சேர்த்துக் கொள்ள ஒப்புதல் அளிக்கிறேன்.

1. இந்த ஆராய்ச்சியின் நோக்கம் மருத்துவமுறைகள் மற்றும் பரிசோதனைமுறைகள் குறித்த விளக்கங்கள் அனைத்தும் எனக்கு திருப்திதரும் வகையில் அளிக்கப்பட்டன.
2. இந்த ஆராய்ச்சிக்காக எனது வாய் முழு பரிசோதனை செய்யப்படும் என்பதை அறிகிறேன்.
3. இந்த ஆராய்ச்சிக்கு தேவையான முழுமையான பரிசோதனைக்கு ஒத்துழைக்க சம்மதிக்கிறேன்.
4. நான் ஏற்கனவே உட்கொண்ட மற்றும் உட்கொள்கிற மருந்துகளைப் பற்றிய விவரங்களை ஆராய்ச்சியாளரிடம் தெரிவித்துள்ளேன்.
5. மருத்துவரின் ஆராய்ச்சிற்கு தேவைப்படும்பொழுது மீண்டும் மருத்துவ ஆய்விற்கு கண்டிப்பாக ஆராய்ச்சியாளரிடம் வர சம்மதிக்கிறேன்.
6. எந்த ஒரு நிலையிலும் நான் இந்த ஆராய்ச்சியிலிருந்து விலகுவதற்கும் அல்லது மருத்துவ ஆராய்ச்சியாளருக்கு என்னை விலக்குவதற்கும் முழு உரிமை இருப்பதாகவும் அறிகிறேன்
7. என் மருத்துவக் குறிப்பேடுகளை இந்த ஆராய்ச்சியில் பயன்படுத்திக்கொள்ள சம்மதிக்கிறேன். இந்த ஆராய்ச்சி மையமும் ஆராய்ச்சியாளரும் என்னுடைய விவரங்கள் அனைத்தையும் இரகசியமாகவைப்பதாக அறிகிறேன்.
8. எனக்கு படிக்கதெரியாததால், மேலே உள்ள அனைத்தையும் கூறக்கேட்டேன்.

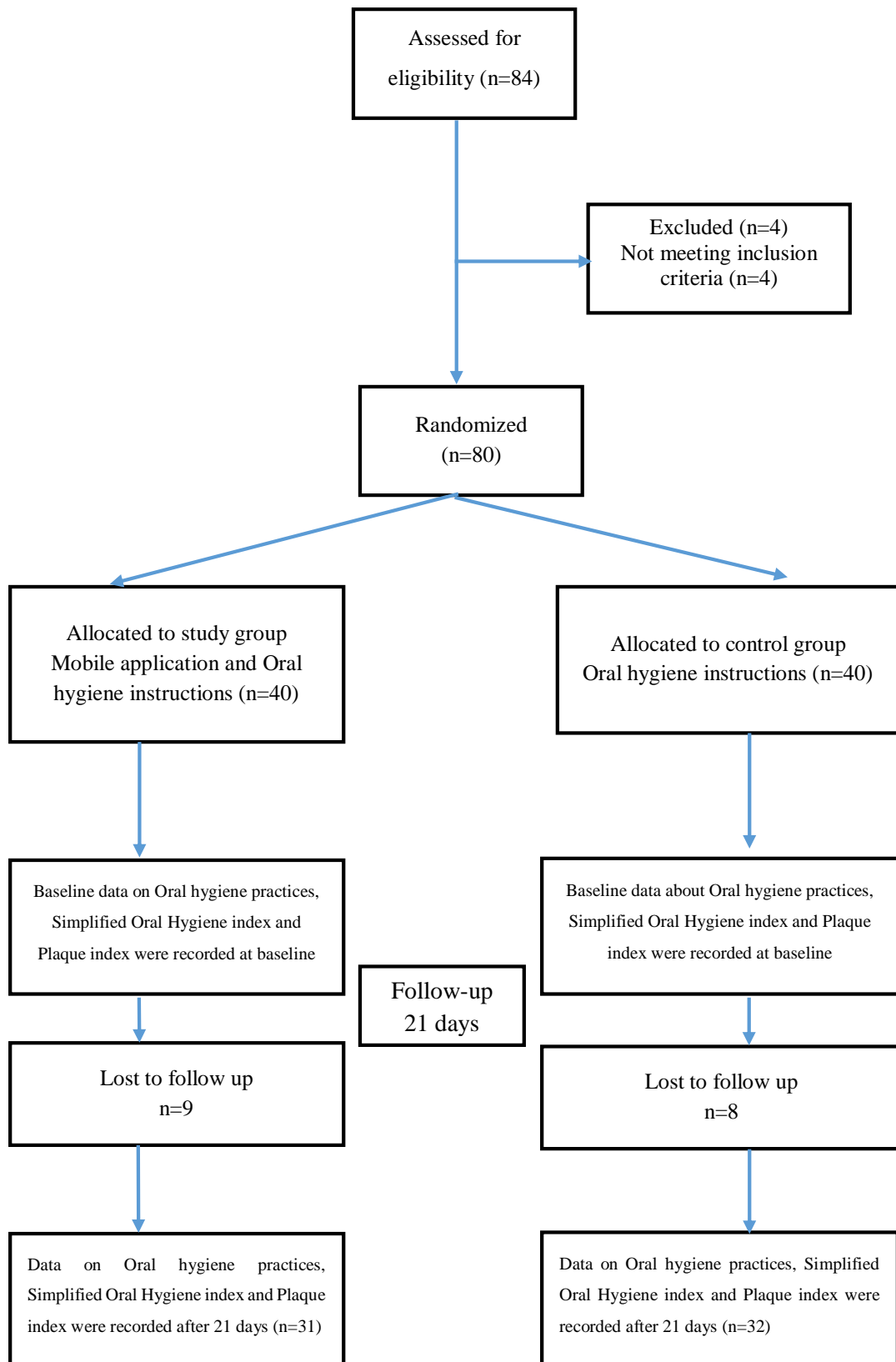
பங்கேற்பாளர் பெயர்

கையொப்பம்/ கைரேகை

தேதி

ஆராய்ச்சியாளர் பெயர்

**DIAGRAM 1: CONSORT FLOW CHART**



**Photograph 1. Instruments used in the study**





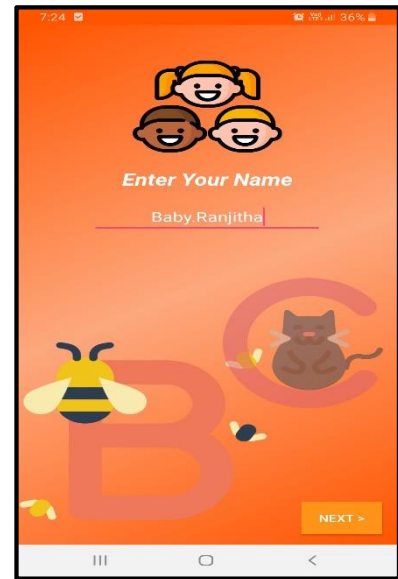
**Photograph 2. Screenshot of the mobile application “Nam Vaai”.**



**APP ICON**



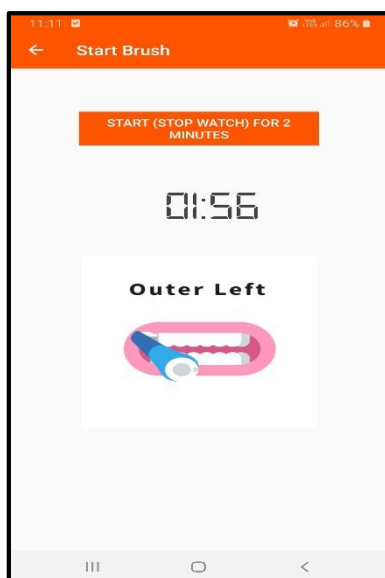
**APP SCREEN**



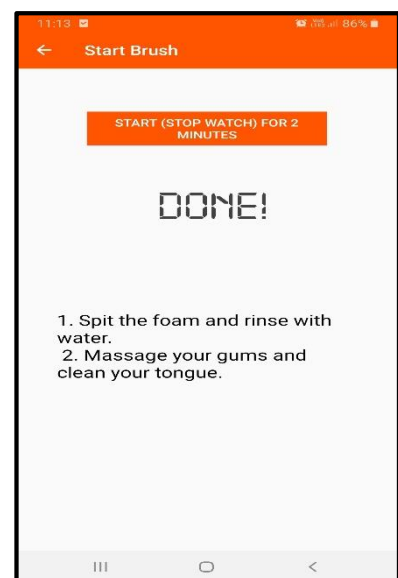
**CREATING A CUSTOMIZED PROFILE**



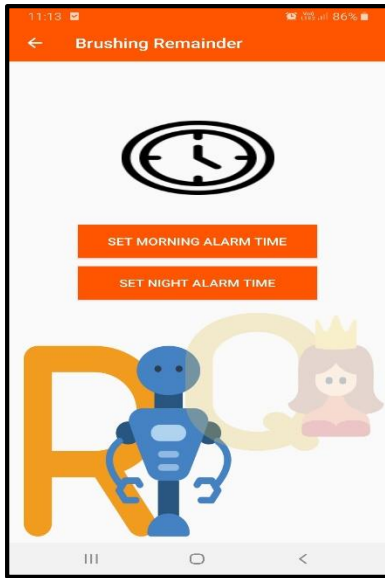
**OPTIONS IN THE HOME SCREEN**



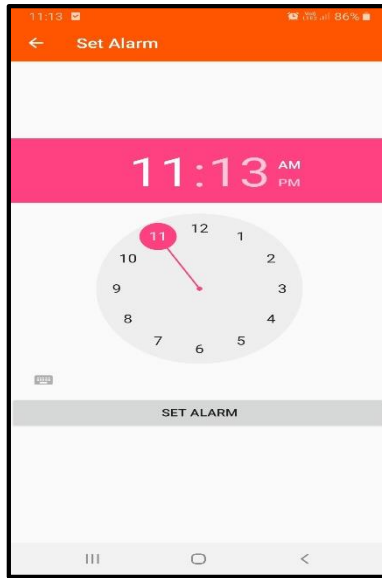
**STOP WATCH TO REGULATE DURATION OF THE TOOTH BRUSHING**



**INSTRUCTIONS AFTER TOOTH BRUSHING**



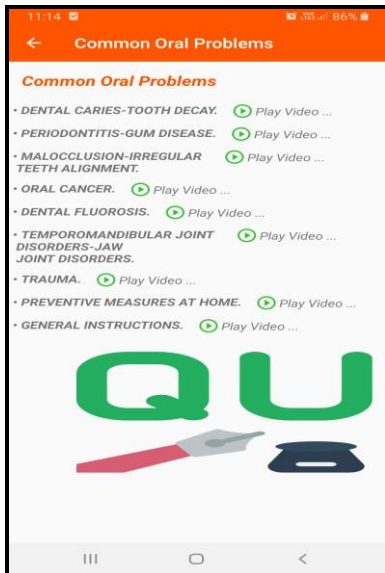
**ALARM TO REMIND  
BRUSHING**



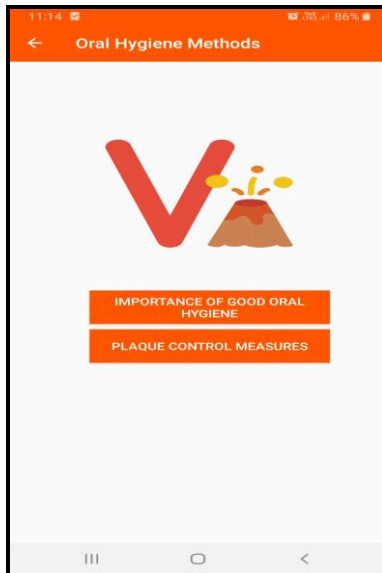
**SETTING  
CUSTOMIZED ALARM**



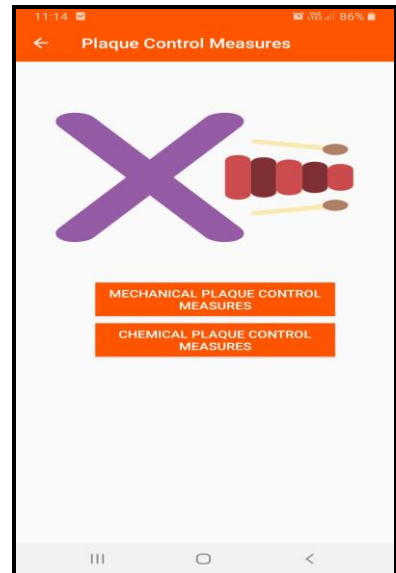
**ORAL HEALTH GUIDE**



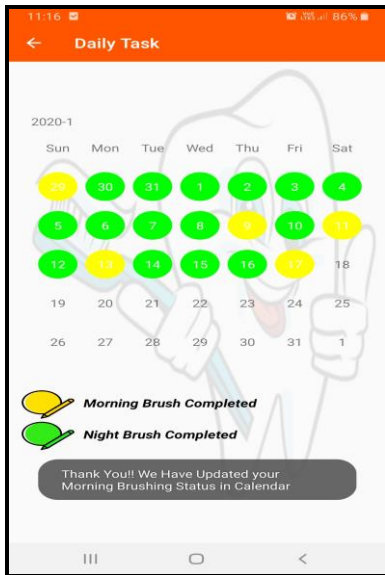
**VIDEOS ON  
ORAL PROBLEMS**



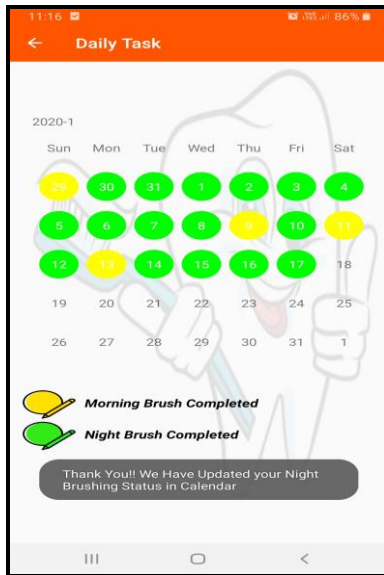
**VIDEOS ON  
ORAL HYGIENE  
METHODS**



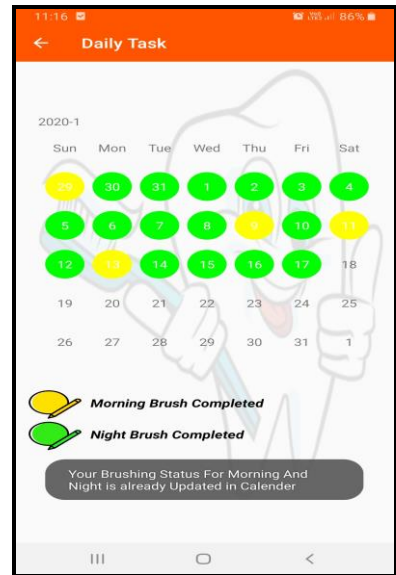
**VIDEOS ON  
PLAQUE CONTROL  
MEASURES**



**UPDATING MORNING BRUSHING STATUS**



**UPDATING NIGHT BRUSHING STATUS**



**NOTIFICATION ABOUT COMPLETING BRUSHING TASK**

**Photograph 3. Chief investigator recording the Simplified Oral hygiene index and Plaque index scores for the participants**



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## **RESULTS**

The present study was conducted to evaluate the effect of time, frequency and duration of brushing on oral hygiene and plaque status of primary school going children.

A total of eighty participants were recruited for the study. But after 21 days, only 63 participants were reported for follow-up. The lost to follow-up was 9 participants in the study group and 8 participants in the control group.

**Table 1** represents the distribution of age of the study and control group participants. The age group was divided into 7-9 years and 10-12 years as per World Health Organisation age criteria. It showed that the mean age of the participants in the study group is  $9.8 \pm 2.4$  years and control group is  $10.5 \pm 1$  years and there was no statistically significant difference ( $P$  value=0.54) between the study and the control group in relation to the mean age of the participants.

**Table 2** represents the distribution of gender of the study participants in study group and control group and it implies that there was no statistically significant difference between the study and the control group participants in relation to gender ( $P$  value=0.63).

**Table 3** represents the distribution of the Socioeconomic status of the study participants in study group and control group and it implies that there was no statistically significant difference between the study and the control group participants in relation to socioeconomic status ( $P$  value=0.46).

**Table 4** represents the intra group comparison of frequency of brushing at baseline and after the intervention in the study group and the control group and it implies that the frequency of brushing has improved in both the groups after the intervention and it is statistically significant with  **$P$  value 0.027** for study group and  **$P$  value 0.002** for control group.

**Table 5** represents the intra group comparison of duration of brushing at baseline and after the intervention in the study group and the control group and it implies that duration of

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brushing has improved in both the groups after the intervention and it is statistically highly significant with ***P* value 0.001** for study group and ***P* value 0.000** for control group.

**Table 6** represents the intra group comparison of method of brushing at baseline and after the intervention in the study group and the control group and it implies that the method of brushing has changed from horizontal strokes to vertical strokes in both the groups after the intervention and it is statistically highly significant with ***P* value 0.012** for study group and ***P* value 0.004** for control group.

**Table 7** represents intergroup comparison of the frequency of brushing at baseline and after the intervention. It implies that only 9.7% of children in study group and 12.5% of children in the control group brushed their teeth twice a day at before the intervention and there was no statistically significant difference (*P* value=0.518) in the frequency of brushing between the study group and the control group at baseline. But after the intervention, 32.3% of children in the study group and 25% of children in the control group brushed their teeth twice a day and there was a statistically highly significant difference (***P* value=0.012**) in the frequency of brushing between the study group and the control group after the intervention.

**Table 8** represents intergroup comparison of the duration of brushing at baseline and after the intervention. It implies that only 12.9% of children in study group and 21.9% of children in the control group brushed for 2-3 minutes duration before the intervention and there was no statistically significant difference (*P* value=0.456) in the duration of brushing between the study group and the control group at baseline. But after the intervention, 67.7% of children in the study group and 62.5% of children in the control group brushed their teeth twice a day and there was a statistically highly significant difference (***P* value =0.017**) in the duration of brushing between the study group and the control group after the intervention.

**Table 9** represents intergroup comparison of the method of brushing at baseline and after the intervention. It implies that only 22.6% of children in study group and 15.6% of children

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in the control group brushed their teeth using vertical strokes before the intervention and there was no statistically significant difference ( $P$  value=0.536) in the method of brushing between the study group and the control group at baseline. But after the intervention, 58.1% of children in the study group and 37.5% of children in the control group brushed their teeth using vertical strokes and there was a statistically significant difference ( $P$  value =**0.038**) in the method of brushing between the study group and the control group after the intervention.

**Table 10** represents the results of Shapiro-Wilk test which was done to check the normality of the data and it implies that the data was Non-normally distributed. Therefore it was decided to perform Non-parametric test for analysing and comparing the Simplified Oral Hygiene index and plaque scores between the groups.

Wilcoxon signed Rank test was done (**Table 11**) to compare the difference in the Simplified Oral Hygiene index and plaque scores at baseline and three weeks after the intervention in both study and control groups individually. It revealed that there was statistically highly significant difference between baseline versus third-week post intervention scores in both the groups ( $P$  value <**0.000**).

**Table 12** demonstrates the difference in Simplified Oral Hygiene index and plaque scores between study and control group at baseline and after the intervention. The results showed that the Simplified Oral Hygiene index and plaque scores were statistically significant at 3<sup>rd</sup> week after the intervention between the study group and the control group with  $P$  value =**0.04** for Simplified Oral Hygiene index scores and  $P$  value =**0.04** for Plaque index scores.

**Table 13** represents the Spearman's Rho correlation coefficient of frequency, duration and method of brushing on Simplified Oral Hygiene index and plaque scores. It showed that there was a moderate correlation ( $r=$ **0.486**) between the frequency of brushing and Simplified Oral hygiene index scores and it was statistically significant ( $P$  value <**0.05**). There was a weak correlation ( $r=$ **0.298**) between the duration of brushing and Simplified Oral hygiene index

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scores and it was statistically significant (***P* value <0.05**). The method of brushing is weakly correlated (***r*=0.351**) with the Simplified Oral hygiene index Scores but it was not statistically significant (***P* value >0.05**).

There was a moderate correlation between the frequency of brushing and Plaque index scores and it was statistically significant with ***P* value <0.05** and duration of brushing was weakly correlated with the Plaque index scores and it was statistically significant (***P* value <0.05**). But the method of brushing which was moderately correlated with Plaque index scores was not statistically significant (***P* value >0.05**). Thus we can conclude that frequency of brushing is more influencing the Simplified Oral hygiene index and Plaque scores followed by duration of brushing. The method of brushing has negligible effects on Simplified Oral hygiene index and Plaque scores.



**Interventions given:**

<b>Group</b>	<b>Interventions</b>
Control group	Oral hygiene instructions were given verbally with demonstration of brushing technique using a model.
Study group	Oral hygiene instructions were given verbally and also through mobile application named “ <b>Nam Vaai</b> ” with demonstration of brushing technique using a model and through animated videos in the mobile application.

**Number of participants recruited and lost to follow-up:**

<b>Group</b>	<b>No of participants recruited initially</b>	<b>No of participants at the end of the study</b>	<b>No of participants lost to follow-up</b>
Study group	40	31	9
Control group	40	32	8

**TABLE 1: AGE DISTRIBUTION OF STUDY AND CONTROL GROUP PARTICIPANTS**

<b>Variables</b>		<b>Study group</b>		<b>Control group</b>		<b>P value</b>
		<b>n</b>	<b>%</b>	<b>n</b>	<b>%</b>	
<b>Age</b>	7-9 years	23	57.5	26	65	--
	10-12 years	17	42.5	14	35	
	Total	40	100	40	100	
<b>Mean Age in Years</b>		9.8±2.4		10.5±1.1		0.54

\*Chi-square test

**TABLE 2: GENDER DISTRIBUTION OF STUDY AND CONTROL GROUP PARTICIPANTS**

<b>Variables</b>		<b>Study group</b>		<b>Control group</b>		<b>P value</b>
		<b>n</b>	<b>%</b>	<b>n</b>	<b>%</b>	
<b>Gender</b>	Male child	22	55	27	67.5	0.63
	Female child	18	45	13	32.5	
	Total	40	100	40	100	

\*Chi-square test

**TABLE 3: SOCIO ECONOMIC STATUS DISTRIBUTION OF STUDY AND CONTROL GROUP PARTICIPANTS**

Variables		Study group		Control group		P value
		n	%	n	%	
SES	Upper	0	0	0	0	0.46
	Upper-Middle	2	5	3	7.5	
	Lower-Middle	9	22.5	8	20	
	Upper-Lower	18	45	16	40	
	Lower	11	27.5	13	32.5	
	Total	40	100	40	100	

\*Chi-square test

**TABLE 4: INTRAGROUP COMPARISON OF FREQUENCY OF BRUSHING AT BASELINE AND 3 WEEKS AFTER INTERVENTION**

Group	Frequency	Baseline		3 weeks		P value
		n	%	n	%	
Study group	Once daily	28	90.3	21	67.7	0.027*
	Twice daily	3	9.7	10	32.3	
	Total	31	100	31	100	
Control group	Once daily	28	87.5	24	75	0.002**
	Twice daily	4	12.5	8	25	
	Total	32	100	32	100	

\*Statistically significant at  $P$  value  $< 0.05$ \*\*Statistically highly significant at  $P$  value  $< 0.01$ 

\*\*\*Chi-square test

**TABLE 5: INTRAGROUP COMPARISON OF DURATION OF BRUSHING AT BASELINE AND 3 WEEKS AFTER INTERVENTION**

Group	Duration	Baseline		3 weeks		P value
		n	%	n	%	
Study group	<2 minutes	15	48.4	2	6.5	0.001*
	2-3 minutes	4	12.9	21	67.7	
	>3 minutes	12	38.7	8	25.8	
	Total	31	100	31	100	
Control group	<2 minutes	11	34.4	7	21.9	0.000*
	2-3 minutes	7	21.9	20	62.5	
	>3 minutes	14	43.8	5	15.6	
	Total	32	100	32	100	

\*Statistically highly significant at  $P$  value  $< 0.01$ 

\*\*Chi-square test

**TABLE 6: INTRAGROUP COMPARISON OF METHOD OF BRUSHING AT BASELINE AND 3 WEEKS AFTER INTERVENTION**

Group	Type of strokes	Baseline		3 weeks		P value
		n	%	n	%	
Study group	Horizontal strokes	24	77.4	8	25.8	<b>0.012*</b>
	Vertical strokes	6	19.4	11	35.5	
	Circular motion	1	3.2	12	38.7	
	Total	31	100	31	100	
Control group	Horizontal strokes	27	84.4	13	40.6	<b>0.004*</b>
	Vertical strokes	3	9.4	12	37.5	
	Circular motion	2	6.2	7	21.9	
	Total	32	100	32	100	

\*Statistically highly significant at  $P$  value  $< 0.01$

\*\*Chi-square test

**TABLE 7: INTERGROUP COMPARISON OF FREQUENCY OF BRUSHING AT BASELINE AND 3 WEEKS AFTER INTERVENTION**

	Frequency	Study group		Control group		P value
		n	%	n	%	
Baseline	Once daily	28	90.3	28	87.5	0.518
	Twice daily	3	9.7	4	12.5	
	Total	31	100	32	100	
3 weeks	Once daily	21	67.7	24	75.0	<b>0.012*</b>
	Twice daily	10	32.3	8	25.0	
	Total	31	100	32	100	

\*Statistically highly significant at  $P$  value  $< 0.01$

\*\*Chi-square test

**TABLE 8: INTERGROUP COMPARISON OF DURATION OF BRUSHING AT BASELINE AND 3 WEEKS AFTER INTERVENTION**

	Duration	Study group		Control group		P value
		n	%	n	%	
Baseline	<2 mins	15	48.4	11	34.4	0.456
	2-3 mins	4	12.9	7	21.9	
	>3 mins	12	38.7	14	43.8	
	Total	31	100	32	100	
3 weeks	<2 mins	2	6.5	7	21.9	<b>0.017*</b>
	2-3 mins	21	67.7	20	62.5	
	>3 mins	8	25.8	5	15.6	
	Total	31	100	32	100	

\*Statistically highly significant at  $P$  value  $< 0.01$

\*\*Chi-square test

**TABLE 9: INTERGOUP COMPARISON OF METHOD OF BRUSHING AT BASELINE AND 3 WEEKS AFTER INTERVENTION**

	Type of strokes	Study group		Control group		P value
		N	%	n	%	
<b>Baseline</b>	Horizontal strokes	24	77.4	27	84.4	0.536
	Vertical strokes	6	19.4	3	9.4	
	Circular motion	1	3.2	2	6.2	
	Total	31	100	32	100	
<b>3 weeks</b>	Horizontal strokes	8	25.8	13	40.6	<b>0.038*</b>
	Vertical strokes	11	35.5	12	37.5	
	Circular motion	12	38.7	7	21.9	
	Total	31	100	32	100	

\*Statistically significant at  $P$  value  $< 0.05$

\*\*Chi-square test

**TABLE 10: TEST OF NORMALITY**

Variables	Shapiro-Wilk	
	Statistic	Sig.
OHI-S Baseline	0.960	<b>0.038*</b>
OHI-S 3 weeks	0.781	<b>0.000**</b>
PI Baseline	0.957	<b>0.027*</b>
PI 3 weeks	0.816	<b>0.000**</b>

\*Statistically significant at  $P$  value  $< 0.05$

\*\*Statistically highly significant at  $P$  value  $< 0.01$

\*\*\*OHI-S – Simplified Oral hygiene index scores, PI- Plaque index scores

**TABLE 11: INTRAGROUP COMPARISON OF ORAL HYGIENE AND PLAQUE INDEX SCORES AT BASELINE AND 3 WEEKS AFTER INTERVENTION USING WILCOXON SIGNED RANK TEST**

Group		Mean	SD	P Value	
<b>Study group</b>	OHI-S	Baseline	1.50	0.77	<b>0.000*</b>
		3 weeks	0.33	0.39	
	PI	Baseline	1.59	0.62	<b>0.000*</b>
		3 weeks	0.27	0.31	
<b>Control group</b>	OHI-S	Baseline	1.65	0.96	<b>0.000*</b>
		3 weeks	0.82	0.89	
	PI	Baseline	1.45	0.77	<b>0.000*</b>
		3 weeks	0.63	0.65	

\*Statistically highly significant at  $P$  value  $< 0.01$

\*\*OHI-S – Simplified Oral hygiene index scores, PI- Plaque index scores

**TABLE 12: INTERGROUP COMPARISON OF ORAL HYGIENE AND PLAQUE INDEX SCORES USING MANN WHITNEY TEST**

		<b>Study group</b>	<b>Control group</b>	<b>P Value</b>
		<b>Mean±SD</b>	<b>Mean±SD</b>	
OHI-S	Baseline	1.50±0.77	1.65±0.96	0.757
	3 weeks	0.33±0.39	0.82±0.89	<b>0.049*</b>
PI	Baseline	1.59±0.62	1.45±0.77	0.409
	3 weeks	0.27±0.31	0.63±0.65	<b>0.044*</b>

\*Statistically significant at  $P$  value  $< 0.05$

\*\*OHI-S – Simplified Oral hygiene index scores, PI- Plaque index scores

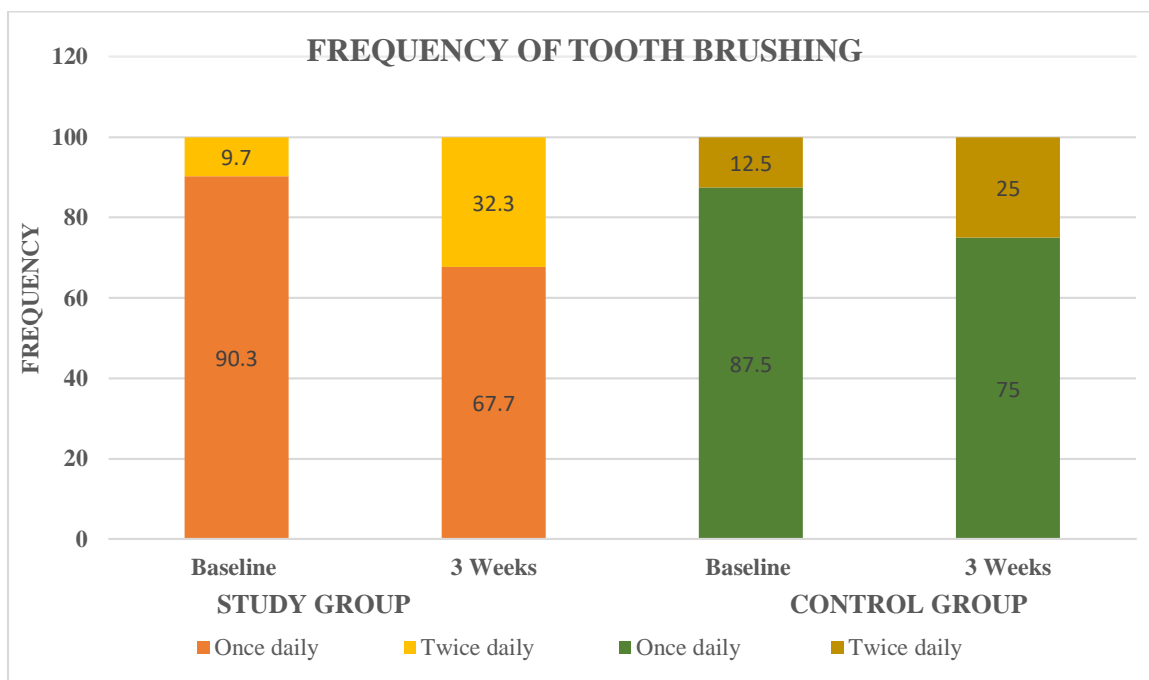
**TABLE 13: SPEARMAN'S RHO CORRELATION COEFFICIENT ( $\rho$ ) OF FREQUENCY, DURATION AND METHOD OF TOOTH BRUSHING ON ORAL HYGIENE AND PLAQUE INDEX SCORES**

		<b>Frequency</b>	<b>Duration</b>	<b>Method</b>
<b>Study group</b>	OHI-S	<b>0.486*</b>	<b>0.298*</b>	0.351
	PI-S	<b>0.434*</b>	<b>0.353*</b>	0.433
<b>Control group</b>	OHI-S	<b>0.422*</b>	<b>0.252*</b>	0.462
	PI-S	<b>0.346*</b>	<b>0.311*</b>	0.368

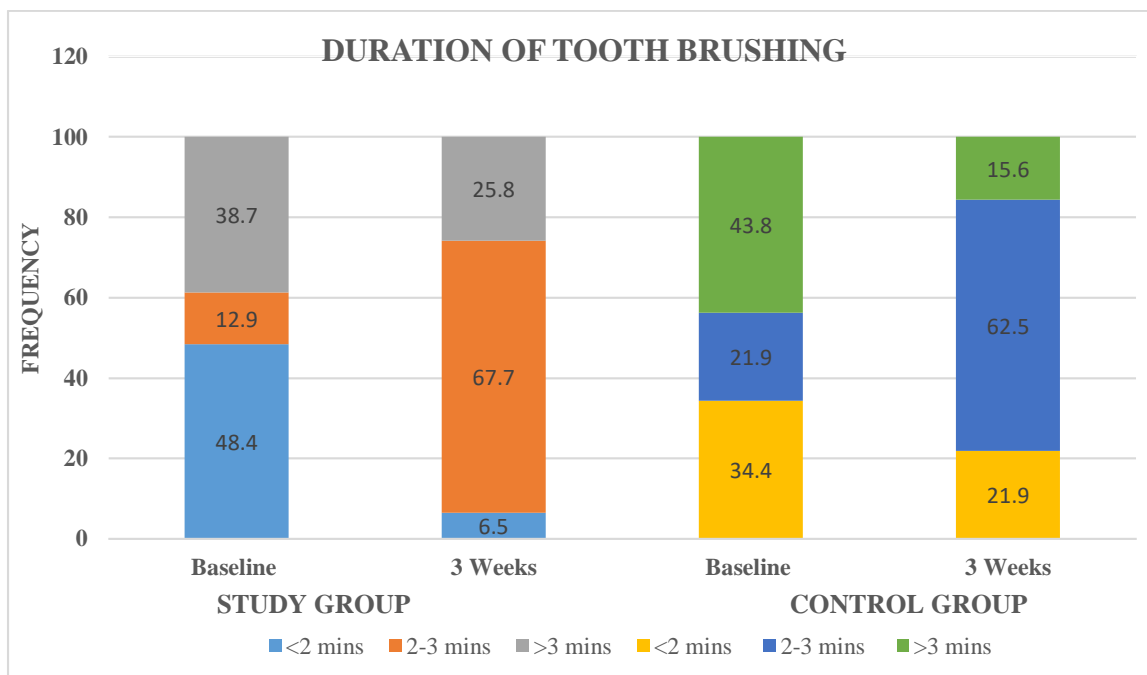
\*Statistically significant at  $P$  value  $< 0.05$

\*\*OHI-S – Simplified Oral hygiene index scores, PI- Plaque index scores

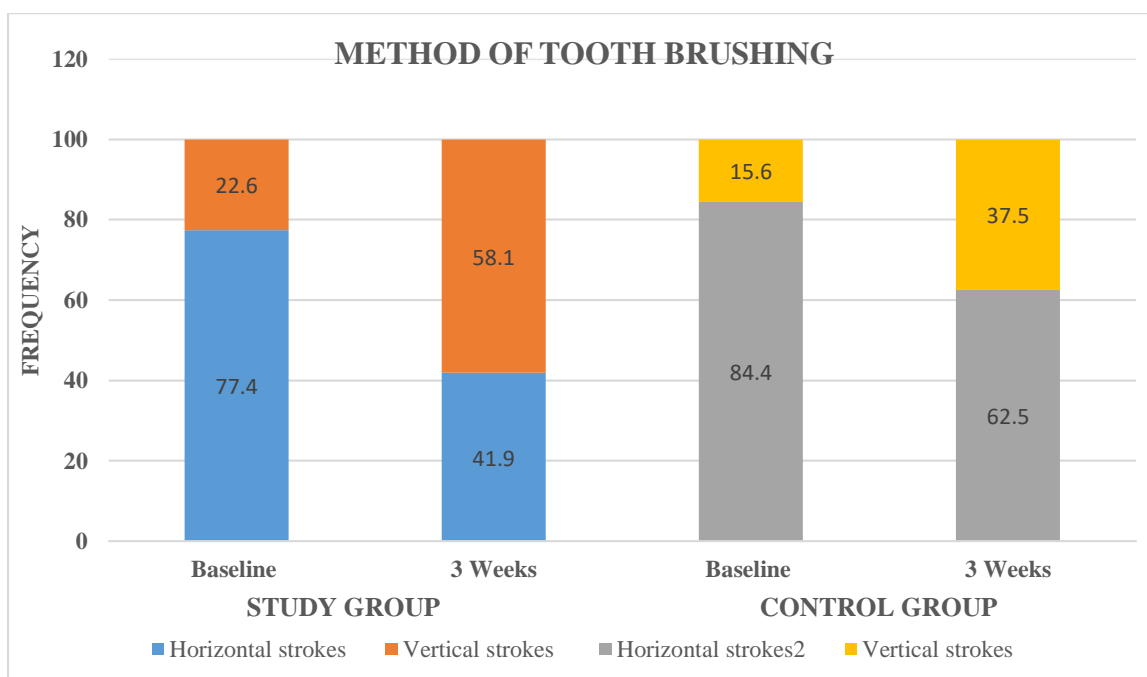
**FIGURE 1: COMPARISON OF FREQUENCY OF TOOTH BRUSHING  
IN STUDY AND CONTROL GROUP**



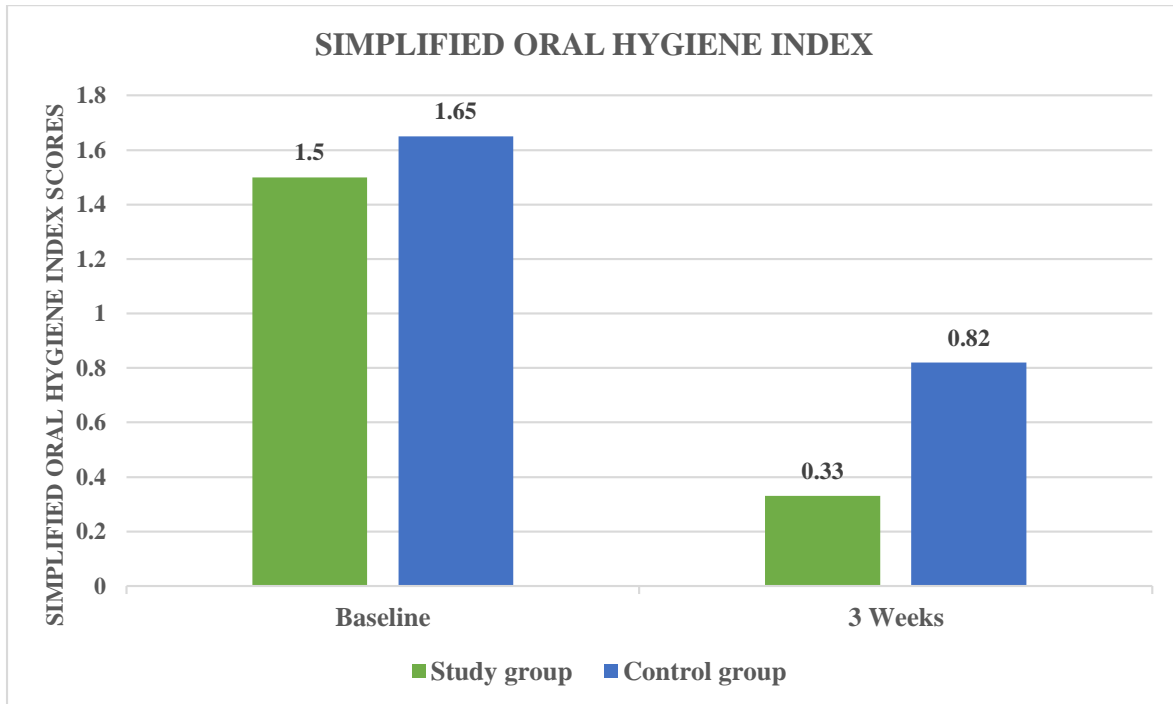
**FIGURE 2: COMPARISON OF DURATION OF TOOTH BRUSHING IN STUDY AND CONTROL GROUP**



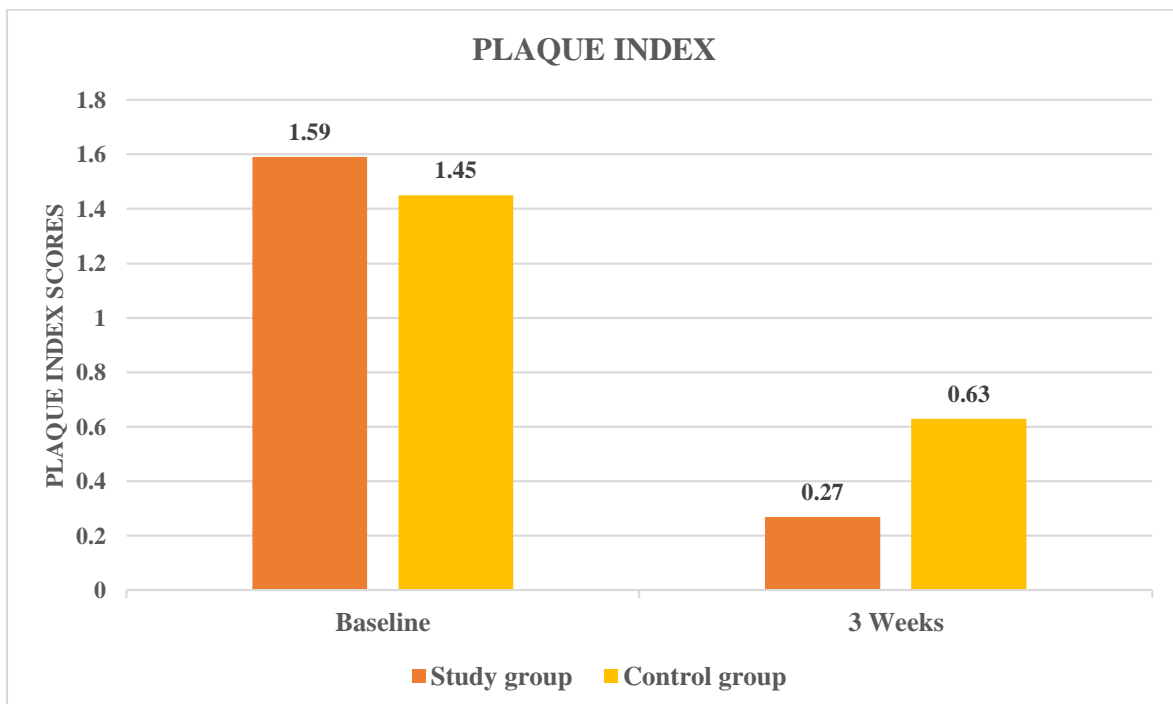
**FIGURE 3: COMPARISON OF METHOD OF TOOTH BRUSHING IN STUDY AND CONTROL GROUP**



**FIGURE 4: COMPARISON OF SIMPLIFIED ORAL HYGIENE INDEX  
IN STUDY AND CONTROL GROUP**



**FIGURE 5: COMPARISON OF PLAQUE INDEX  
IN STUDY AND CONTROL GROUP**





## **DISCUSSION**

Despite Dental caries and periodontal disease being preventable, it is estimated that these conditions are highly prevalent, affecting approximately 3.5 billion people worldwide. Oral health is integral to overall health with oral disease contributing to unnecessary pain and suffering. Routine oral hygiene, including daily tooth brushing and interdental cleaning, is important for preventing oral diseases and maintaining good oral health.<sup>(21)</sup>

Children lack cooperation and compliance in performing daily oral hygiene practices.<sup>(22)</sup> Therefore, the goal of achieving good oral health among Children is a challenging to Oral health care professionals. Furthermore, evidences show that, even today, many children do not visit a Dental Surgeon before the development of permanent teeth and it seems to be especially related to socio-economic level of families and to knowledge about the Dental care needing in childhood.<sup>(23)</sup>

Social media is a vital aspect of teenagers' and children's social and creative lives. Children use social media to have fun, make and maintain friendships, share interests, explore identities and develop relationships with family. It is an extension of their offline and face-to-face interactions.<sup>(24)</sup> We can make use of this technology to improve the Oral hygiene of children. Therefore the study was planned with an objective to evaluate the effect of time, frequency and duration of brushing on Oral hygiene and Plaque status of Primary school going children by creating a standardised mobile application.

The participants of the present study were children aged 7-12 years. This is a period where exfoliation of deciduous dentition and eruption of permanent dentition takes place. Presence of newly erupted hypomineralised permanent teeth coupled with peer influence on their dietary pattern make this mixed dentition period highly susceptible to Dental caries.

The skill to perform tooth brushing develops from early ages up to adolescence, and from the age around six, children often are given an increasing responsibility for their tooth-brushing. A study by *Steffie et al* showed that the household daily routines, such as doing chores and being responsible for one's own belongings, are set by age 9.<sup>(25)</sup> It can be difficult to change established oral health behaviour during adolescence. Moreover, a study conducted by *DA Christakis et al* showed that six-year-olds understand digital technology better than adults.<sup>(26)</sup> Since this is the age where internalisation of habit takes place, we have selected this age group to inculcate good Oral hygiene practices on a routine basis.

The participants of this study were randomly allocated to the study and control group using a computer generated sequence of numbers thereby eliminating the allocation bias. The participants in the study group received Mobile App whereas participants in the control group received conventional Oral hygiene instructions. Though various health education aids were used to improve the oral hygiene practices, the use of Mobile app for this purpose has many advantages over traditional methods like leaflets as there is no printing, storage, distribution, or disposal cost associated with an app. Apps are instantly scalable and updatable with the cost of producing one app being the same as any multiple, unlike a physical product. Apps can use local reminders generated by the app itself, so they have an advantage over text message reminders, which have been used to motivate better oral health. Text messaging offers only passive engagement and can have a financial cost to the receiver and sender. Text messaging requires a person to give out their telephone number, which then needs to be stored giving possible concerns about confidentiality and data protection. The cost effectiveness of an app requires further investigation.

Moreover, use of technological devices and applications in oral hygiene management seemed to be effective in improving compliance of young patients and recent literature

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provided encouraging results in this field, especially in orthodontic patients and this work was based on these considerations.

The app investigated in the current study uses a number of recognised behaviour change techniques to motivate an evidence-based routine oral health practices. The most important aspect of the Mobile App was motivation of the individual user of the app and as well for parents to motivate their child/children to brush their teeth. This was done by incorporating reminders and stop watches to self-monitor the frequency and duration of tooth brushing which finally was reflected in a compliance chart of the App. The second major theme of the App was creation of awareness about oral diseases and plaque control measures using animated videos. The helpfulness of the animated videos showing how to carry out oral hygiene task was reported. The use of animated videos to convey a health message has been shown to be effective resulting in long-term knowledge retention.

The follow-up period was set for 21 days because Dr. Maltz states clearly that it takes a minimum of twenty-one days to form a new mental image (i.e. habit) to develop.<sup>(27)</sup> At that point, they would have accustomed to perform the habit on a daily basis and will find it much easier to continue it, even if it's not quite automatic yet. But at the end of the 21 days, we were not able to contact 17 participants and thus they were lost to follow-up.

Analysis of the results shows that there is no statistically significant difference in the frequency, duration and method of brushing of the participants between the study group and the control group at the baseline. However, 21 days after the intervention, the participant's Oral hygiene behaviours such as frequency, duration and method of brushing improved significantly in both study group and control group with more percentage of participants improved their behaviour in the study group compared to participants in the control group and this difference is statistically significant with  $P < 0.05$ .

This might be interpreted in terms as an indication that though chair-side Oral hygiene instructions significantly improved the Oral hygiene behaviour but it did not reach the goal of improving compliance as much as that of the mobile application over time. Input of mobile apps for oral hygiene practices, on the other hand, allowed obtaining better results in terms of improvement in the Oral hygiene practices, thus proving that social media could be a good support in changing the Oral health behaviour, increasing cooperation of children and motivating them on an evidence-based oral health practices.

We observed in this study, that the participants in the study group who received mobile app showed better improvement in their Oral hygiene compared to the participants in the control group who received chair-side conventional Oral hygiene instructions alone.

There was a statistically significant reduction in the Simplified Oral hygiene index and Plaque index scores among the participants in both groups before and after the intervention. The difference in Simplified Oral hygiene index and Plaque index scores between the study and control groups at the baseline were found to be statistically insignificant ( $P>0.05$ ). But 21 days after the intervention, the Simplified Oral hygiene index and Plaque index scores has reduced significantly in both groups but the reduction in the scores was little higher in the study group compared to the control group and this difference in reduction in the Simplified Oral hygiene index and Plaque index scores between the study group and the control group is statistically significant ( $P<0.05$ ). This difference could be explained by the fact that it might be possible that the mobile apps used by the participants in the study group were self-encouraged and motivated in performing oral hygiene practices.

These findings are in accordance with a study conducted by Francesca Zotti et al, 2019 which showed that the participants who received mobile app showed lower oral hygiene and

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Plaque index scores than those in the control group concluding that apps in children allowed achieving encouraging results with improvement of oral hygiene and health.<sup>(13)</sup>

Results of this study showed an improvement of compliance in oral hygiene performances of children when they are engaged by technological supports, properly designed to enhance this issue, despite the low educational attainment of parents. This study showed that introduction of apps for domiciliary oral hygiene is almost evenly well received in all young patients.

Parents' role are essential in this regard providing important feedback about cooperation and engagement of children; it could become a further resource to better customize the choice of media supports used to increase compliance.<sup>(28)</sup> This concept serves good practicability especially in private practices, where Dental Surgeons, young patients and their parents have a closer and more continuous relationship compared with those of great hospital facilities.

**STRENGTHS:**

1. The Mobile App was developed user-friendly to the target group by a trained and competent Software Engineer. None of the participants expressed difficulty in usage of the mobile application throughout the intervention period.
2. The animations videos incorporated in the Mobile App not only motivated the children to improve their oral hygiene practices but also created awareness about various oral diseases and the various plaque control measures.
3. A standard Paediatric toothbrush and toothpaste was given to both the study and control group participants. Thus, the differences in the outcome could be attributed only to the effect of Mobile App in the study group and the conventional Oral Hygiene Instructions in the control group.

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4. Compliance assessment in the study group was incorporated in the Mobile App itself whereas in the control group a separate compliance sheet was given to the participants.
  5. Periodic reminders and reinforcements were given for the participants in both groups. In the study group it was done through features inbuilt within the Mobile App whereas in the control group it was done through telephonic calls once in a week.

**LIMITATIONS:**

1. The study outcome could have been influenced by novelty effect, which is the tendency for performance to initially improve when new technology is introduced, not because of any actual improvement in learning or achievement, but in response to increased interest in the new technology.
2. The long-term maintenance of oral hygiene behaviour or relapse was not assessed as the participants were followed up only for a period of 21 days.
3. The participant's oral hygiene practices such as frequency, duration and method of tooth brushing was assessed subjectively using a questionnaire. The participant's response might have been influenced by Social desirability bias, which is a type of response bias where the respondents will answer the questions in a manner that will be viewed favourably by others.
4. Changes in the behaviour using psychosocial behaviour model was not assessed in the present study. However, oral hygiene status as a surrogate measure was assessed objectively using standardized indices.

Despite the limitation, the use of Mobile App could serve as a tool in oral health promotion which is evidence based, scientifically sound, technologically driven, cost-effective and most importantly socially acceptable to the population. However, the cost-effectiveness of

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delivering mobile app over conventional health education methods warrants further investigation. Additionally, the usage of applications in mobile phones for promotion of children's oral health should be weighed against the adverse effects of smartphone addiction.

## **SUMMARY AND CONCLUSION**

The World Health Organization (WHO) recently published a global overview of Oral health, a statement that described the approaches to oral disease prevention and promotion of Oral health during the 21st century. The report emphasized that, despite great improvements in the Oral health status of populations across the world, problems still persist.<sup>(21)</sup>

Although data show that oral health can be improved through effective plaque control measures, mechanical plaque control failing to deliver optimal levels of Oral health because the techniques are not done consistently or thoroughly, especially in children and patients with Prosthodontic or Orthodontic appliances. These limitations on home oral care practices suggest that other strategies for improving the oral hygiene practice is urgently required. Therefore, our study aimed to evaluate the newly created Oral health education mobile application for altering the frequency and duration of tooth brushing in improving Oral hygiene and plaque status of primary school going children.

An Android based mobile application named “**Nam vaai**” was developed with features to improve the Oral hygiene practices. Eighty study participants were randomly recruited and allocated into one of the two intervention groups. Details about participant’s Oral hygiene practices which includes frequency, duration and method of brushing were noted and their baseline Simplified Oral hygiene index and Plaque index scores were recorded. Chair-side Oral hygiene instructions were given to the participants in the control group and the mobile application (**Nam vaai**) along with the Oral hygiene instructions were given to the participants in the study group. The participants were followed up for a period of 21 days. Again details about participant’s Oral hygiene practices and Simplified Oral hygiene index and Plaque index scores were recorded at the end of 21<sup>st</sup> day.



The study showed that Oral hygiene behaviours such as frequency of brushing, duration of brushing and method of brushing has significantly improved in both study group and the control group but the percentage of participants who changes their Oral hygiene behaviour was higher in study group compared to control group which is statistically significant ( $P<0.05$ ).

Thus, the study established scientifically that mobile app is a promising tool to motivate an evidence-based oral hygiene routine. It will greatly improve the Oral hygiene behaviour which in turns will improve the Oral hygiene status of the individual, thus reducing the Oral disease burden of the community.

## **RECOMMENDATION**

Mobile technologies can be used as an adjunct component in the improvement of daily self-performed oral hygiene. Further studies should be developed to evaluate such mobile applications as adjunct interventions to supplement standard oral care for patients in different age groups and to assess effectiveness and cost effectiveness of an app compared to current methods used to motivate an evidence-based oral hygiene routine in the population. Important opportunities exist to develop oral health promotion apps whose content is scientifically sound and evidence-based and that adhere to good design principles for persuasive health technologies.

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**ANNEXURE**

**ANNEXURE 1: Permission letter to recruit participants from the Department of Pedodontics and Preventive Dentistry, Tamil Nadu Government Dental College and Hospital**

To DR. Balasharmugan, Ho.D of Paedodontics  
to kindly allow the PG student who needs  
to do the study  
12/11/2019

From,  
Dr.M.B.Asath Narayanan., B.Sc., MDS.,  
Professor and Head,  
Department of Public Health Dentistry,  
Tamil Nadu Government Dental College and Hospital,  
Chennai- 600 003.

To,  
The Principal,  
Tamil Nadu Government Dental College and Hospital,  
Chennai- 600 003.

Madam,

Sub:Permission to recruit participants from the Department of Pediatric and Preventive Dentistry,  
TNGDCH, Chennai - reg.

This is to kindly inform you that Dr.S.Rajeshwari, III year Postgraduate student from this Department is undergoing a Thesis titled "Evaluation of effect of time, frequency and duration of brushing on Oral hygiene and plaque status of primary school going children by creating a standardised mobile application" as a part of her PG curriculum.

Methodology of the study:

Sample size :80 participants  
Study population :5 to 12 year old patients attending outpatient department  
Duration of the study :1 month  
Time of recruitment :07:30 AM to 12.00 PM  
Days required for recruitment :Till the required sample size is achieved

I kindly request you to permit her to recruit participants from the Department of Pediatric and Preventive Dentistry, Tamil Nadu Government Dental College and Hospital for the same.

Thanking You,

Yours faithfully,

Date: 12/11/2019  
Place: Chennai

Dr.M.B.Asath Narayanan

Kindly do the  
needful  
① Dr. Sharmila  
② Dr. Ramesh

12/11/2019

**ANNEXURE 2: Random sequence of numbers generated by Research  
randomizer**

**RESULTS**

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20 Sets of 4 Numbers Per Set  
Range: From 1 to 2

- Set #1**  
1, 1, 1, 2
- Set #2**  
2, 1, 1, 2
- Set #3**  
2, 1, 2, 2
- Set #4**  
2, 1, 1, 2
- Set #5**  
2, 2, 2, 1
- Set #6**  
1, 1, 2, 1
- Set #7**  
1, 2, 1, 2
- Set #8**  
1, 1, 2, 1
- Set #9**  
1, 1, 1, 2
- Set #10**  
1, 1, 2, 2
- Set #11**  
2, 2, 1, 2
- Set #12**  
1, 2, 1, 1
- Set #13**



2, 2, 2, 1

**Set #14**

1, 2, 1, 1

**Set #15**

1, 2, 1, 2

**Set #16**

2, 1, 2, 2

**Set #17**

2, 2, 2, 1

**Set #18**

2, 2, 1, 2

**Set #19**

1, 1, 2, 1

**Set #20**

2, 1, 2, 2

## ANNEXURE 3: Master table containing all the data taken in the study

**Study Group**

PT. NO	Name	Age	Sex	SES	Baseline					3 weeks				
					FB	DB	MB	OHIS	PI	FB	DB	MB	OHIS	PI
1	S.Abishek	0	0	2	1	0	0	2.3	2.1	1	1	2	0.9	0.5
2	A.Kaviya	1	1	4	1	1	0	2.2	2.4	1	1	1	0.5	1
3	H.Vinod	1	0	1	1	1	1	1.5	1.2	1	1	1	1	0
4	P.Tamilselvan	1	0	3	1	0	0	1	1.3	2	1	1	0.4	0.2
5	K.Vikram	0	0	4	2	1	1	2.3	2.2	2	1	1	0.6	0.7
6	R.Kishore	1	0	3	1	2	0	1.9	2	2	2	0	0.3	0.8
7	S.Anitha	0	1	4	1	2	0	1.7	1.8	1	1	2	0.4	0.5
8	V.Ram kumar	0	0	4	1	2	1	0.8	0.8	1	2	1	0	0
9	B.Ameer	1	0	3	1	2	0	1.4	1.8	1	1	1	0	0
10	K.Swetha	0	1	3	1	0	0	0.9	1	1	0	2	0.1	0
11	V.Vasan	1	0	2	1	2	2	0.4	0.6	1	2	2	0	0
12	V.Gokulnathan	0	0	3	1	2	0	1.1	1	1	2	0	0.1	0.1
13	M.Nandhini	1	1	1	1	2	1	3.5	2.3	1	2	2	1.4	0.3
14	S.Thilak	0	0	3	1	0	0	0.8	0.8	1	1	2	0.1	0
15	S.Sriram	1	0	4	1	0	0	1.9	2	1	1	2	0.1	0.1
16	S.Pavithra	0	1	4	1	0	1	0.9	0.9	1	1	1	0.5	0
17	S.Punithan	0	0	4	1	0	0	1.6	2	1	1	2	0	0.1
18	R.Vasanth	1	0	4	1	1	1	0.3	0.8	1	1	1	0	0
19	A.Praveen	1	0	3	2	0	0	2.1	2.5	2	1	0	0.3	0.6
20	A.Kavitha	0	1	4	1	0	0	1.3	1.4	1	1	2	0.2	0.3
21	K.Akshaya	1	1	3	1	2	0	0.4	0.6	1	1	0	0	0
22	T.Samuel	0	0	4	1	2	0	2.4	2.5	2	2	1	0.4	0.6
23	G.Sruthi	0	1	3	1	2	0	2.7	2	2	2	0	0.9	0.5
24	H.Raghu	1	0	4	1	2	0	1.5	1.9	1	2	2	0.1	0.5
25	B.Afreen	1	1	2	1	0	0	0.9	1.3	1	1	0	0	0
26	H.Gayathri	0	1	2	1	0	0	1.8	2.1	1	0	2	0.2	0.2
27	V.Manikandan	0	0	3	1	0	0	0.9	1.3	2	1	0	0.1	0.1
28	S.Siddarth	0	0	3	1	0	0	2.6	2.5	1	1	1	1.3	0.9
29	S.Raghavi	1	1	3	2	0	0	2	2.2	2	1	1	0.3	0.6
30	F.Sherin	1	1	3	1	2	0	0.6	0.8	2	1	0	0	0
31	V.Venkatesh	0	0	2	1	0	0	1.1	1.4	2	1	2	0.1	0

**Control group**

PT.No	Name	Age	Sex	SES	Baseline					3 weeks				
					FB	DB	MB	OHIS	PI	FB	DB	MB	OHIS	PI
1	K.Ishwarya	0	1	1	1	0	0	0.6	0.5	1	1	1	0.1	0
2	T.Harish	1	0	2	1	0	0	1.6	1.6	2	1	1	0.6	0.1
3	V.Gokul	0	0	4	1	2	0	2.2	2.1	1	2	1	1.6	1.1
4	G.Tharshini	1	1	3	1	2	0	1.7	1.5	1	2	2	1.1	1
5	S.Hariharan	1	0	4	2	0	0	0.8	0.6	2	1	0	0	0
6	L.Gowri	0	1	3	1	2	1	2.4	2.2	1	1	2	1.3	1.4
7	E.Angelin	1	1	2	1	2	0	1.9	1.5	1	1	1	0.7	0.6
8	B.Rizwana	1	1	4	1	0	0	1.7	1.5	2	2	0	1.1	0.9
9	S.Raghuram	0	0	3	1	1	2	0.4	0.4	1	1	2	0	0
10	S.Kishore	1	0	1	1	2	0	3.5	2.8	1	0	1	2.5	1.4
11	S.Saroach	0	0	4	2	0	0	1.2	1.2	2	0	2	0.5	0.4
12	M.Pavithran	1	0	3	1	0	0	0.7	0.5	1	1	0	0	0
13	S.Srinivas	0	0	2	1	2	0	2.2	2	1	1	1	1.3	1.4
14	K.Vanitha	1	1	4	1	1	2	1.5	1.3	1	1	2	0.1	0.1
15	A.Priyanka	0	1	4	1	2	0	2.3	2	1	0	0	1.6	1.5
16	K.Vinoth	0	0	4	1	1	0	0.2	0.1	2	1	1	0	0
17	A.Aarthi	1	1	1	2	0	0	2.9	2.4	2	0	0	2.1	1.5
18	H.Varun	0	0	2	1	1	1	1.3	1.1	1	1	1	0.2	0.1
19	S.Swetha	1	1	3	1	2	0	4.1	2.7	1	2	2	3.4	1.8
20	S.Surya	1	0	3	1	2	0	1.8	2	1	1	0	0.6	0.7
21	S.Nandhini	0	1	3	1	0	0	3.2	2.6	1	1	1	1.9	1
22	V.Yashwanth	1	0	3	1	2	0	0.9	0.5	1	1	0	0.1	0.2
23	T.Sonu	0	1	3	1	1	0	0.7	1	1	1	0	0	0
24	D.Vikram	1	0	4	2	2	0	1.1	1.1	2	2	0	0.2	0.1
25	S.Sakthi	0	0	3	1	0	0	2	1.8	1	0	0	1.1	1.3
26	S.Sai pallavi	1	1	3	1	2	0	1.9	2.1	2	1	0	0.3	0.1
27	T.Arun Mathew	1	0	4	1	2	0	1.4	1.7	1	0	0	0.2	0.2
28	K.Mithran	0	0	3	1	1	1	0.5	0.5	1	1	1	0	0
29	G.Vetrivelan	0	0	3	1	0	0	0.5	0.6	1	0	0	0	0
30	F.Ayesha	1	1	3	1	1	0	3	2.5	1	1	0	2.4	2
31	R.Sandhiya	1	1	3	1	2	0	1.8	1.7	1	1	0	1.1	1.4
32	G.Yamini	0	1	3	1	0	0	0.8	0.5	1	1	2	0.2	0.1

**ABBREVIATIONS**

<b>Abbreviation</b>	<b>Description</b>
PT: No	Patient number
SES	Socioeconomic status
FB	Frequency of brushing
DB	Duration of brushing
MB	Method of brushing
OHI-S	Simplified Oral Hygiene index
PI	Plaque index

**CODING THE VARIABLES**

<b>Variables</b>	<b>Codes</b>	<b>Description</b>
<b>Age</b>	0	7-9 years
	1	10-12 years
<b>Sex</b>	0	Male
	1	Female
<b>Socioeconomic status</b>	0	Upper
	1	Upper middle
	2	Lower middle
	3	Upper lower
	4	Lower
<b>Frequency of brushing</b>	0	Once daily
	1	Twice daily
<b>Duration of brushing</b>	0	<2minutes
	1	2-3 minutes
	2	>3minutes
<b>Method of brushing</b>	0	Horizontal strokes
	1	Vertical strokes
	2	Circular motion