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ORIGINAL RESEARCH

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Effectiveness of motivational interviewing, animation videos, and jaw model instruction on oral hygiene in 4–6 years old children: a randomized controlled trial

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Abstract

Background: Dental caries is the most common noncommunicable disease worldwide, particularly affecting young children due to ineffective plaque control. Effective and engaging oral health education methods are critical for establishing proper brushing habits in early childhood. This study aimed to evaluate the impact of different tooth brushing training methods on dental plaque accumulation in preschool-aged children. **Methods**: This randomized controlled trial included 45 healthy children aged 4–6 years. Participants were randomly assigned into three groups (n=15 each): a control group receiving traditional instruction using a jaw model, an animation video group, and a motivational interviewing (MI) group. The plaque index (PI) was recorded at baseline and two weeks after the interventions. Gender distribution was also evaluated in relation to PI outcomes. Statistical analysis was performed using appropriate comparative tests with significance set at ($p < 0.05$). **Results**: Significant reductions in plaque index scores were observed in both the MI group (baseline: 1.9 ± 0.5; follow-up: 1.26 ± 0.55) and animation video groups (baseline: 1.77 ± 0.72; follow-up: 1.34 ± 0.62) ($p < 0.05$). The control group showed no statistically significant change in PI scores. Gender had no significant effect on plaque index outcomes. **Conclusions**: Motivational interviewing and animated video-based education were more effective than traditional jaw model instruction in reducing dental plaque in preschool children. These interactive and child-friendly approaches may enhance the effectiveness of oral hygiene education in early childhood settings and could be recommended for widespread use in preventive pediatric dentistry programs. **Clinical Trial Registration**: This study was registered with the Thai Clinical Trials Registry (code: TCTR20240628004).

Keywords

Toothbrushing; Oral Hygiene; Motivational Interviewing; Education, Preschool Children

1. Introduction

Early childhood caries (ECC) is defined as the presence of one or more decayed, missing or filled tooth surfaces in any primary tooth of children under 72 months old [1]. According to the World Health Organization (WHO), ECC prevalence by continents is: Africa 30%, Americas 48%, Asia 52%, Europe 43% and Oceania 82%. While the global ECC prevalence is reported to be 48%, a study conducted in Erzurum, a province in Turkey where our study was carried out, reported an ECC prevalence of 73% [1, 2]. This elevated prevalence in Erzurum may be attributed to several local factors, including the region's lower socioeconomic status, inadequate oral hygiene practices, and limited awareness of preventive dental care. These local factors reflect broader global challenges in reducing dental caries, as a substantial percentage of children worldwide continue to suffer from tooth decay despite concerted efforts. In Turkey, although preventive dental health initiatives are in place, the persistently high rate of caries presents a considerable financial burden on both individuals and society [3].

Dental caries, one of the most prevalent chronic diseases in the world, is brought on by plaque that bacteria in the mouth create as a result of poor oral hygiene. When people do not regularly brush their teeth, bacteria in the plaque that builds up on the teeth break down sugars and carbohydrates to produce acids that erode tooth enamel and cause mineral loss [4]. It is crucial to start regular and efficient tooth brushing habits in preschool for children to develop good oral health.

Preschool is an ideal time to shape behaviors in a positive way. Children during this time period have poor oral health because they often do not brush their teeth according to recommended guidelines and may not be closely monitored by their

parents while they brush [5]. During this time, health education can significantly increase knowledge about oral health and promote the development of healthy habits [6].

There are studies in the literature in which oral health education was utilized to improve tooth brushing habits in different age groups [7, 8]. For example, educational interventions targeting adolescents have shown significant improvements in oral hygiene and reductions in dental plaque and caries incidence [9]. Similarly, programs designed for younger children have emphasized the importance of early habit formation, leading to better long-term oral health outcomes [5, 8]. These studies highlight the critical role of tailored educational approaches in fostering positive oral health behaviors.

The three primary methods of oral health education are oral, written and audio-visual methods [9]. Each of these methods has specific impacts on behavior change: oral methods often involve direct communication and interactive sessions, which can be effective in providing immediate feedback and motivation [10]; written methods, such as pamphlets and brochures, provide tangible information that can be referenced multiple times [11]; and audio-visual methods, including videos and animations, engage multiple senses and can be particularly effective in maintaining attention and reinforcing learning through visual and auditory stimuli [12, 13].

Motivational interviewing (MI), a verbal approach to behavior change, is a person-centered, collaborative communication style that aims to improve health behaviors by stimulating intrinsic motivation [14]. MI encourages individuals to resolve ambivalence toward behavior change by engaging them in reflective discussions that highlight personal choice and responsibility. This approach is particularly effective in oral health education, as it helps patients identify barriers to proper oral hygiene and overcome these barriers through self-motivation [15]. Additionally, MI takes into account the individual's sociocultural context, making it especially suitable for younger populations where family dynamics and environmental factors play significant roles. Studies on the use and effectiveness of the MI technique in dentistry have been of significant interest in recent years, particularly in improving oral hygiene and promoting long-term behavioral changes [16]. Furthermore, trainings with a jaw model were proven to be beneficial in audiovisual approaches. Video-assisted education, another audiovisual method, can also be a useful tool for teaching children about tooth brushing, as it utilizes colorful and engaging animations [7, 12, 17].

There are disagreements regarding the best technique for oral health education, despite the fact that there are numerous studies on the subject in the literature [17–19]. Furthermore, a thorough search of the relevant literature revealed limited research on the impact of parent-assisted MI on the tooth brushing habits of preschool children. Although some studies focus on the use of MI for older children and adolescents [20], few specifically investigate its application for preschool children with parental involvement [21]. This gap in the literature highlights the need for more research on how MI can influence the oral health behaviors of preschool children. The present study aimed to compare the effectiveness of MI, animation videos, and jaw modeling (control group) in improving tooth brushing efficacy among children aged 4–6 years. The null hypothesis of the study is that there is no significant difference in the effectiveness of MI, animation videos, and jaw modeling in improving tooth brushing efficacy among children aged 4–6 years.

The implications of this research for public health and clinical practice are significant. Identifying the most effective educational methods for improving oral hygiene in preschool children can inform strategies to prevent dental caries and promote early oral health, leading to more targeted interventions and better outcomes for children.

2. Materials and methods

2.1 Participants

This randomized controlled trial was performed on 45 healthy children aged 4–6 years who were admitted to Atatürk University's Faculty of Dentistry Pediatric Dentistry Clinics between January and March 2024. The sample size was determined based on a previous study [22], which indicated a need for 15 participants per group to achieve a power of 80%, with a standard deviation of 0.1 and a significance level of 5%. The effect size was calculated to detect a difference of 0.11 between groups. The sample size calculation was performed using G*Power software (version 3.1.9, Heinrich Heine University, Dusseldorf, NRW, Germany). All participants received oral hygiene education (OHE) on a jaw model. Stratified randomization by sex and age was performed by generating numbers for each group using www.randomizer.org. Participants were sequentially assigned to one of three groups by researcher ZY based on their assigned numbers, and this process continued until the required sample size was achieved.

Group 1: Control group (received only OHE on the jaw model);

Group 2: Received OHE on jaw model + motivational interviewing;

Group 3: Received OHE on jaw model + animation video.

Healthy, medically sound children aged 4–6 years who volunteered for the study and whose parents or legal guardians provided consent were included in the study. Patients excluded from the study were those with permanent or removable orthodontic appliances or retainers, sensitivity to toothpaste, medications that may cause drug-induced gingivitis, chronic illnesses, physical limitations that restrict mobility, and vision or hearing impairments that hinder effective communication.

2.2 Interventions

2.2.1 Control group

Following a brief introduction to basic dental hygiene, participants in control group learned fundamental facts about tooth surfaces using a pediatric jaw model by a trained researcher (FS). The technique for brushing the buccal (outer), lingual/palatal (inner), and occlusal (chewing) surfaces of the teeth was demonstrated using Fone's method [23]. The participants were then asked to replicate these processes on the model. Appropriate toothbrushes were provided, and the participants were subsequently observed brushing their own teeth in front of a mirror.

2.2.2 Basic OHE with motivational interviewing

Following a brief introduction to basic oral hygiene, the children were asked to talk about their reasons for visiting the dentist, as well as their knowledge, attitudes, and behaviors related to dental care. The MI intervention, conducted in the Miller and Rollnick style [15], was carried out by a trained researcher (FS) in a quiet room with the parents present and lasted approximately 15 minutes. The session was tailored to the children's developmental level by using simple language, visual aids and open-ended questions that encouraged the children to express their views in an age-appropriate manner. The main focus of the conversation during the MI was the children's views on their current decay activities and its effects on their past, present and future. The interview began with an open-ended question asking the children why they visited the dentist and encouraging them to share their views on the appearance and health of their teeth. Specific strategies for behavioral changes regarding tooth brushing and consumption of cariogenic foods were identified and reinforced. Children with low motivation and readiness for change in their tooth brushing habits were encouraged to express their ambivalence about brushing. Self-efficacy was enhanced by involving the children as active agents in stopping the development of dental caries, allowing them to take charge of their dental health.

2.2.3 Basic OHE with animation video

Following instruction on basic oral hygiene, virtual reality goggles were used in the clinic while the children were in the dental unit to display an age-appropriate animation film tailored to OHE by a trained researcher (FS). The animation video, which lasted approximately 3 minutes, featured colorful and engaging animations that demonstrated proper tooth brushing techniques and emphasized the importance of maintaining good oral hygiene. The content was specifically designed to be developmentally appropriate for children aged 4–6, using vibrant visuals and simplified explanations to ensure understanding. The instruction was delivered individually to each participant to ensure personalized attention and to address any specific questions or concerns. The animation video was then shared with the parents for further viewing.

In addition, recommendations were made to all groups to minimize the intake of sugary snacks and to schedule routine dental checkups.

2.2.4 Clinical measurements

Each participant's biographical information (age, sex and overall health status), current oral health, reason for visiting the dentist, and brushing habits were obtained by having the participants' parents or legal guardians complete a questionnaire consisting of open-ended questions.

A plaque disclosing solution was used to effectively visualize the dental plaque. All children's baseline plaque index (PI) scores (baseline measurement) were measured by a single blinded investigator (PC) using the Silness and Loe [24] method. After summing the tooth scores and dividing by the number of teeth, the average PI score was obtained. Subsequently, the children were included in the interventions according to their assigned groups.

A soft toothbrush (0.22 mm) suggested for use with children this age was given to each participant for the duration of the trial. Children participating in the study were instructed to brush their teeth twice a day, in the morning and before bed, and to schedule a follow-up appointment for two weeks later. Parents were urged to remind their children to brush their teeth once in the morning and once before bed.

At the two-week follow-up, the PI (second measurement) score was measured by the investigator (PC) without performing any procedures on the children.

Participants, parents and those analyzing the data were blinded to group assignments to prevent bias in the study outcomes. Blinding was maintained by ensuring that participants and parents were provided with identical educational materials, and group assignments were not disclosed. The data analysts received anonymized datasets with coded group identifiers, ensuring they were unaware of the specific intervention assigned to each group.

2.3 Statistical evaluation

The study included descriptive statistics for the following data sets: number, percentage, mean, standard deviation, minimum, maximum and median. Normality assumption was verified using the Shapiro Wilk test and homogeneity of variance was checked using Levene's test. When the assumptions were not met, the Mann-Whitney U test was employed, and the Independent Sample t test was utilized to compare the means of two independent groups with normal distribution. For the comparison of PI change scores across study groups at different measurement times, analysis of variance (ANOVA) was conducted, followed by dependent sample t-tests for the various measurement times within the study groups. Cohen's d was calculated to evaluate the effect sizes for pairwise comparisons between groups, providing insight into the magnitude of the observed differences. In addition to p-values, 95% confidence intervals for mean differences were calculated to provide further context on the precision of the estimates. The Pearson Chi-Square test was performed to analyze the association between categorical variables. Analyses were performed in IBM SPSS Statistics® version 25 (IBM Corp, Armonk, NY, USA) with significance set at $p < 0.05$.

3. Results

As shown in Table 1, the demographic characteristics of the study groups and the distribution of responses to the questionnaire are detailed below. Initially, 300 children were screened for eligibility. Of these, 45 children aged 4–6 years met the inclusion criteria and were included in the study, with a nearly equal distribution of boys and girls within the groups. No statistically significant relationships were found between the study groups, demographic characteristics, and the answers to the questions in the analyses.

As outlined in Table 2, the mean plaque index (PI) scores for each study group, along with their respective 95% confidence intervals (CI), are presented. At baseline, the MI group exhibited the highest PI score (1.90 $\pm$ 0.50, 95% CI:

TABLE 1. Relationships and cross-tables of characteristics related to study groups.

	Control group		Motivational interviewing		Animation video		*p*
	n	%	n	%	n	%	
Gender							
Girl	11	73.3	7	46.7	10	66.7	0.239
Boy	4	26.7	8	53.3	5	33.3	
Age							
4 years old	5	33.3	8	53.3	3	20.0	
5 years old	4	26.7	6	40.0	8	53.3	0.136
6 years old	6	40.0	1	6.7	4	26.7	
How is your child's overall oral health?							
Perfect	2	13.3	1	20.0	0	0.0	
Very good	0	0.0	0	0.0	0	0.0	
Good	1	6.7	2	13.3	2	13.3	0.104
Moderate	6	40.0	6	40.0	12	80.0	
Bad	6	40.0	4	26.7	1	6.7	
When was the last time your child brushed their teeth?							
This morning	11	73.3	6	40.0	6	40.0	
Last night	2	13.3	5	33.3	4	26.7	0.353
Other	2	13.3	4	26.7	5	33.3	
How often does your child brush their teeth?							
Once a day	8	53.3	5	33.3	6	40.0	
Two or more per day	2	13.3	3	20.0	2	13.3	0.630
Several times a week	3	20.0	6	40.0	7	46.7	
Doesn't brush	2	13.3	1	6.7	0	0.0	
How often does your child visit the dentist?							
6–12 month	5	33.3	2	13.3	4	26.7	
In the presence of pain	10	66.7	13	86.7	9	60.0	0.263
None	0	0.0	0	0.0	2	13.3	

TABLE 2. Distribution and comparison of plaque index with 95% confidence intervals according to study groups and measurement times.

Groups	First examination		Second examination		p_1
	Mean ± SD	95% CI	Mean ± SD	95% CI	
Control group	1.73 ± 0.49	(14.57, 20.02)	1.57 ± 0.35	(13.78, 17.69)	0.331
Motivational interviewing	1.90 ± 0.50	(16.27, 21.77)	1.26 ± 0.55	(0.96, 15.67)	0.001*
Animation video	1.77 ± 0.72	(13.66, 21.65)	1.34 ± 0.62	(0.99, 16.85)	0.039*
p_2	0.692		0.249		

*$p < 0.05$.
SD: Standard deviation; CI: Confidence interval; p_1: Within-group p values; p_2: Between-group p values.

(6.27, 21.77)), while the control group had the lowest (1.73 ± 0.49, 95% CI: (14.57, 20.02)). In the second measurements, this pattern was reversed, with the MI group recording the lowest PI score (1.26 ± 0.55, 95% CI: (0.96, 15.67)) and the control group the highest (1.57 ± 0.35, 95% CI: (13.78, 17.69)). Despite these differences, no statistically significant variation was found between the groups at either the baseline ($p = 0.692$) or second measurements ($p = 0.249$). Significant within-group reductions in PI scores were observed in both the MI and animation video groups ($p < 0.05$), whereas the control group showed no significant change. The greatest reduction in PI was noted in the MI group, although this improvement did not reach statistical significance when compared to the other groups.

The Cohen's *d* effect sizes, presented in Table 3, offer further insight into the observed differences. A medium effect size was noted between the MI group and the control group at the second examination ($d = 0.67$), while a smaller effect size was found between the control and animation video groups ($d = 0.46$). The comparison between the MI and animation video groups indicated a small, non-significant effect ($d = -0.14$). These effect sizes suggest that although improvements were observed, particularly in the MI and animation video groups, the magnitude of these changes did not result in statistically significant group differences.

As shown in Table 4, the PI change scores of the study groups by gender are detailed below. While no statistically significant differences were observed between female and male participants in any of the groups, the Cohen's *d* effect sizes suggest small to moderate practical differences, particularly in the motivational interviewing and animation video groups.

4. Discussion

Basic OHE is considered an important and integral part of dental health services. Educational methods vary widely, from providing basic oral health information to implementing complex programs involving psychological and behavioral strategies. These trainings aim to enhance knowledge, attitudes, beliefs, behaviors, use of dental services, and oral health status [9]. This study aimed to compare the effects of tooth brushing training delivered through hands-on lectures with a jaw model, animation videos, and MI methods on improving tooth brushing efficacy in children aged 4–6 years, using the PI as an assessment tool. The findings revealed significant reductions in PI within the MI and animation video groups, indicating the effectiveness of these methods in plaque reduction. However, the differences between the groups were not statistically significant, meaning the null hypothesis—stating no significant difference between the methods—could not be rejected. A thorough literature review revealed no prior studies comparing the effect of oral hygiene training using MI on PI in this age group against training on a jaw model using hands-on lectures and animated videos.

MI has recently become an innovative behavioral intervention for improving oral health in children, adolescents and adults [6]. Studies evaluating the effectiveness of MI in maintaining and improving periodontal health, malnutrition, substance abuse, smoking cessation, and weight loss in adults have shown that MI is similar [25] or superior [26]

TABLE 3. Cohen's *d* effect sizes for pairwise comparisons between study groups.

Comparison	Cohen's *d* (First Examination)	Cohen's *d* (Second Examination)
Control *vs.* Motivational interviewing	−0.34	0.67
Control *vs.* Animation video	−0.06	0.46
Motivational interviewing *vs.* Animation video	0.21	−0.14

TABLE 4. Distribution and comparison of plaque index change scores with 95% confidence intervals, and Cohen's *d* effect sizes by gender for study groups.

Groups	Gender	n	Mean ± SD	95% CI	*p*	Cohen's *d*
Control group						
	Girl	11	0.44 ± 0.52	(0.09, 0.79)	0.851§	0.15
	Boy	4	0.37 ± 0.15	(0.13, 0.60)		
Motivational interviewing						
	Girl	7	0.77 ± 0.49	(0.32, 1.23)	0.336§	0.37
	Boy	8	0.57 ± 0.58	(0.09, 1.05)		
Animation video						
	Girl	10	0.57 ± 0.44	(0.25, 0.88)	0.376†	−0.51
	Boy	5	0.83 ± 0.65	(0.02, 1.63)		

SD: Standard deviation; CI: Confidence interval.
§*: Mann-Whitney U.*
†*: Independent sample t test.*

to traditional training and motivational techniques. MI has been reported to be a reliable intervention method to reduce avoidance of dental care among adolescents [27]. While much of the existing research focuses on older children, there is increasing evidence of MI's efficacy in younger populations. For instance, MI conducted for the prevention of ECC has been shown to aid children in acquiring toothbrushing habits, increase family precautions against caries, and reduce the number of new caries lesions in a year [18, 28, 29]. However, many MI studies have primarily targeted parents, aiming to change parental behaviors to improve children's oral health [30, 31]. In contrast, our study applied MI directly to children aged 4–6 years, fostering intrinsic motivation and improving toothbrushing efficacy. MI fosters cognitive development by engaging children in reflective conversations, promoting autonomy, decision-making, and self-regulation—skills aligned with their developmental stage [32]. These cognitive benefits help children internalize healthy behaviors like toothbrushing. The significant reduction in plaque index (PI) in our MI group suggests MI's potential for improving oral hygiene in young children. Further comprehensive research is recommended to assess MI's long-term impact in preschool and kindergarten populations.

The integration of animated videos in this study aimed to leverage modern technology for improved engagement. Animation videos engage children visually, which enhances attention and learning through relatable, age-appropriate content [33]. Additionally, animated videos may foster positive behavior through mechanisms such as habit formation and imitation. It has been found that animated videos have a strong, positive effect on children, especially those in younger age groups, whose habits and behaviors are still being formed, as they mimic the actions of the animated characters and adopt what they learn from them as habits [13]. In addition, it has been reported that virtual reality training is more effective in improving oral health and reducing plaque buildup in the mouth compared to the traditional method [34]. Video training (animation, cartoons) has been reported to have positive effects on toothbrushing habits and PI in different age groups [13, 19, 35]. Similar to the literature, a statistically significant decrease in the PI was observed in the second PI scores in the animation group compared to their initial PI scores. The positive effects of animated movies in forming toothbrushing habits and attitudes in children within this study may be attributed to the fact that the habits of these children aged 4–6 years are still being formed. Additionally, it is believed that this significant difference may be related to the use of virtual reality goggles, rather than watching an animation video on a computer, television or iPad. In the fight against caries caused by plaque accumulation due to insufficient tooth brushing, incorporating visuals that emphasize caries prevention in animated films may serve as an effective strategy to alleviate children's anxiety related to dental pain and reduce the overall costs associated with oral and dental healthcare.

A common method for protecting and improving oral health and acquiring basic oral hygiene habits used within OHE is practical demonstration using the jaw model. This type of training aims to illustrate how to perform basic oral hygiene techniques using a real mouth structure. In the studies where oral and dental health training was conducted using the jaw model, participants' dental hygiene and oral health improved as the toothbrushing technique was taught vertically, horizontally, circularly, and physiologically for each part of the mouth [36]. However, the results of the current study showed that toothbrushing training provided only on the jaw model was not effective in the 4–6 age group. This finding may be attributed to the motor skills development stage of preschool children, who may find it challenging to replicate complex brushing techniques. Therefore, integrating other educational methods that cater to the developmental capabilities of young children, such as animation videos or MI, may be more effective in promoting proper oral hygiene practices in this age group.

It has been reported that age, sex, cultural, social and biological factors may be effective in the acquisition and maintenance of habits [37]. The present study focused on children aged 4 to 6, as early childhood is a critical period for establishing healthy habits. Additionally, the literature reveals the following: in a study conducted on 15-year-old adolescents, it was reported that training using video was more effective in improving the oral health of boys [38]; in another study conducted on 12-year-old children, toothbrushing training via pamphlet caused a greater decrease in PI in boys than in girls [19]; and in another study examining the effect of one-time toothbrushing training using video on PI in the 8–12 age group, it was reported that boys acquired more tooth brushing habits [7]. Contrary to these studies, no statistically significant difference was observed between PI change scores by sex in all groups in the present study. It is believed that this difference may be due to the difference in the age groups selected in the studies. Given the impact of developmental differences on the effectiveness of motivational strategies, it is crucial to tailor interventions to specific age groups.

One study showed that there may be differences in the plaque removal efficiency of new or used toothbrushes [39]. Therefore, toothbrushes selected in accordance with the age of the participating children were given as gifts in the present study to prevent the effect of new or worn brushes on plaque removal function and to ensure standardization between the groups. It is worth noting that the gift brushes in this study may be partially effective in the detected plaque reduction due to novelty and transient behavioral changes expressed as "Novelty" and the "Hawthorne effect" [40].

Some limitations should be taken into account when interpreting the findings of this study. The children who participated in the study were aware that their tooth brushing was being observed and evaluated; so, they may have tried to improve tooth brushing. The relatively small sample size of the study may not be sufficient to detect treatment effects, and the short follow-up period of two weeks does not provide insight into the long-term sustainability of the outcomes. Long-term follow-up studies are needed to evaluate the sustained impact of MI and animation videos on tooth brushing habits. Additionally, this study may not have fully accounted for cultural attitudes toward oral hygiene, healthcare practices, or socioeconomic disparities that can influence children's oral health behaviors. Despite these limitations, the study has several strengths. It explores innovative approaches, such as MI and animation videos, tailored for younger children,

and provides evidence of their effectiveness in improving oral hygiene behaviors in this age group, an area with limited existing research. These findings have important implications for public health and clinical practice. In public health settings, integrating MI and animation videos could be a cost-effective and scalable strategy for promoting oral hygiene in younger populations, particularly in underserved communities where access to traditional education is limited. Clinically, dental professionals could incorporate these methods into routine care to improve engagement and education, especially during preventive care programs. Future studies with larger, more diverse sample sizes and longer follow-up periods are recommended to provide a better understanding of the long-term effects of these interventions. Additionally, considering cultural and contextual factors in future research may enhance the effectiveness and relevance of oral health interventions across different populations.

5. Conclusions

This study highlights the potential of motivational interviewing (MI) and animation-based oral hygiene education in reducing plaque index (PI) scores in children aged 4–6 years. The significant PI reductions observed in the MI and animation video groups, compared to the minimal changes in the jaw model group, suggest that interactive and engaging interventions can foster better oral hygiene practices in young children. While the effect sizes suggest meaningful improvements, particularly in the MI group, further research is needed to establish the long-term sustainability of these effects. Future initiatives could incorporate MI and animation videos as viable tools for public health interventions, with a particular focus on scalability and adaptation to different cultural and socioeconomic contexts. The practical benefits of these interventions, coupled with their positive behavioral impact, support their inclusion in routine dental education programs to enhance oral health outcomes in children.

ABBREVIATIONS

ECC, early childhood caries; MI, motivational interviewing; OHE, oral hygiene education; PI, plaque index; WHO, World Health Organization; ANOVA, analysis of variance; CI, confidence intervals.

AVAILABILITY OF DATA AND MATERIALS

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

AUTHOR CONTRIBUTIONS

PC—investigation, conceptualization, methodology, writing-original draft. ZY, FSa—visualization, writing-review & editing. FSe, AB—investigation, writing-review & editing. SSD—conceptualization, supervision, writing-review & editing. All authors discussed the results and commented on the manuscript. All authors contributed to the study conception and design.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The local Ethics Committee of the Department of Medicine at Atatürk University (472, 06 January 2023) approved the study protocol after it was determined to be in accordance with local laws and the principles of the Declaration of Helsinki. The study was registered in the Thai Clinical Trials Registry (code: TCTR20240628004). Written informed consent was obtained from the parents of all participants in the study.

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CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests, personal relationships, or potential conflicts of interest that could have appeared to influence the authorship, publication, or content of this article.

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