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EVALUATION OF THE IMPACT OF MATERNAL EDUCATIONAL MODELS ON EARLY CHILDHOOD CARIES IN PRETERM INFANTS

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ABSTRACT

Purpose: This prospective cohort study aimed to assess the impact of different educational models on maternal awareness and dental caries development in preterm infants.
Methods: This study included 56 preterm infants and their mothers. Participants were divided into two groups based on the education models provided to their mothers: visual and verbal education (Group 1) and verbal education alone (Group 2). Mothers received either visual or verbal presentations focusing on maternal oral hygiene, early childhood caries, and infant oral hygiene. Training and oral examinations were repeated at 3-month intervals for 18 months. Intraoral examinations of the infants were performed again 9 months after the last visit. Demographic factors, oral hygiene and caries development were assessed through clinical examinations and questionnaires.

Results: There is no significant difference in demographic variables between the two groups. Both education models significantly increased maternal knowledge, as evidenced by pre-test and post-test scores (p=0.001). However, no statistically significant difference was observed in caries development between the two groups (p=0.322). Only verbal education and visual and verbal education methods were effective in preventing early childhood caries.
Conclusion: The study demonstrates that both visual and verbal educational models, repeated at frequent intervals, effectively increase maternal knowledge about oral and dental health in preterm infants.

KEYWORDS: maternal education, early childhood caries, preterm infants, oral health awareness

INTRODUCTION

The oral and dental health of prematurely born children has become an increasingly prominent focus of interest in the field of healthcare. Premature birth, as defined by the World Health Organization, refers to infants born before completing the 37th week of gestation, with further categorizations based on gestational age into extremely preterm (before 28 weeks), very preterm (between 28 and 32 weeks), and moderate to late preterm (between 32 and 37 weeks) subgroups (Blencowe et al., 2012). Preterm children can be influenced by factors related to both the prenatal and postnatal periods, which can significantly impact their oral health (Blencowe et al., 2012).

The definition of early childhood caries (ECC) includes the presence of one or more decayed, missing, or filled tooth surfaces in any tooth in a child younger than 71 months (Plutzer and Spencer, 2008). The process of enamel formation, mineralization and maturation can be affected by systemic disturbances in preterm infants, leading to defects such as opacities or hypoplasia in the enamel matrix (Nelson et al., 2013). The association observed between developmental enamel defects (DED) and early childhood caries (ECC) underline the significance of DED (Corrêa-Faria et al., 2020). In addition, the feeding patterns of preterm children, involving frequent feeding throughout the day and night to achieve adequate weight gain, may increase the risk of exposure to sugary liquids, posing a significant threat to dental health (Hallas et al., 2015a).

Effectively preventing and treating ECC requires an understanding of the underlying causes and their interrelationships (Tinanoff et al., 2019). In this context, parental education and childhood dental caries prevention strategies hold significant importance.

Educational models can play a pivotal role in safeguarding the dental health of prematurely born children. Oral and dental health education provided to mothers of newborns is a fundamental component of strategies for preventing dental caries. These educational

programs aim to inform mothers about their newborns' oral and dental health and to teach good oral hygiene habits (Hallas et al., 2015a).

Verbal communication is often the first and most used method. Verbal discourse and face-to-face interaction are integral components of the educational process. However, it is crucial to recognize that verbal education and informational presentations, when delivered in isolation and as one-time events, tend to be less enduring and effective. To maximize efficiency and knowledge retention, it is essential to complement verbal instruction with reinforcement methods, such as guided repetition and written educational materials (Friedman et al., 2011).

Beyond verbal instruction, it is imperative to go further to ensure the effectiveness of educational methods. Consequently, the need arises to augment these methods with written educational materials. Brochures, booklets, and posters are just a few examples of written materials that can complement verbal explanations, serving as reminders and enhancing the retention of crucial information (Johnson and Sandford, 2005a). Educating families through written materials can provide a lasting learning experience for both parents and children.

This study aims to evaluate the impact of different maternal education models on dental and oral health among preterm infants.

METHODS

Ethical Aspects

The protocol of the present study was validated by the Marmara University Faculty of Medicine's Clinical Research Ethics Committee with the project number of 2019-360.

Study Population

In our study, a prospective cohort study was planned, including dental examinations of premature infants and their mothers, along with visual and verbal educational sessions. The study was conducted at the Marmara University Physical Therapy and Pediatric Rehabilitation Clinic between January 1, 2020, and December 1, 2022. During the study period, a total of 56 preterm children and their mothers who applied to the Marmara University Pendik Education and Research Hospital Physical Therapy and Pediatric Rehabilitation Clinic participated in the research. The inclusion criteria for patient selection in the study were preterm birth, being less than 9 months old, and the absence of tooth eruption. All 56 children were included in the study. Each study group consists of 28 children.

The clinical examinations, face-to-face meetings with mothers, and educational sessions were conducted by the researcher, who is affiliated with the Department of Pediatric Dentistry at Marmara University Faculty of Dentistry, at Marmara University Pendik Education and Research Hospital Physical Therapy and Pediatric Rehabilitation Clinic.

Questionnaires

Following the examinations, a 6-item questionnaire was administered to assess mothers' knowledge levels concerning early childhood caries, children's oral hygiene, and proper dietary habits (Hallas et al., 2015a). Subsequently, mothers were questioned using a survey form. The questions containing twenty-two questions, including child and mother's birth data, level of mothers' education, smoking status of parents, monthly family income, mother's plaque index, mother's caries index. Questionnaire was administered and completed by dental examiner prior to intraoral examination.

Intra Oral Examinations

In order to record initial lesions during oral examinations conducted on mothers initially and during follow-up checks on children, the International Caries Classification and Management System (ICCMS) Caries Categories, which are categorized by combining the International Caries Detection and Assessment System (ICDAS) classifications for coronal caries lesions, were employed (Pitts et al., 2014).

The presence of plaque was also evaluated during the examinations. For the ease of assessing plaque in infants, the plaque index introduced by Alaluusua and Malmivirta, focusing on plaque accumulation on the buccal surfaces of anterior teeth, was utilized (Alaluusua and Malmivirta, 1994).

Educational Interventions

All participating patients' mothers received visual or verbal presentations, focusing on the impact of maternal oral hygiene and their children's oral and dental health, early childhood caries, maintaining infant oral hygiene.

In our study, 56 patients were randomized into two different groups. As the educational model, Group 1 comprised 28 individuals who received both verbal and visual presentations. They also received verbal education repetition and visual brochures at three-month follow-up appointments. Training was repeated for 18 months during the initial examination and subsequent quarterly follow-up examinations, along with oral examinations of the infant's.

Group 2, consisting of 28 individuals, received only verbal education and had this training verbally repeated during the three-month follow-up appointments, along with infant's oral examinations, for a total of 18 months. The educational sessions were completed at the 18th month. At the nine months after the last visit, patients were recalled for reevaluation of caries development and brushing habits.

Follow-up Assessments

During follow-up examinations, the eruption times of teeth were recorded. Dietary habits after transitioning to solid foods were recorded. Caries formation and the presence of dental plaque were assessed.

At the end of the follow-up appointments, mothers were re-administered a 6-item test to assess their knowledge about maintaining children's oral hygiene and proper dietary habits, as was done at the beginning of the study.

Statistical Method

The normality of numerical variables was tested using the Shapiro-Wilk test. The relationships between categorical variables were assessed through the Chi-square test. The impact of groups in comparing pre-posttest measurements was examined using two-way repeated measures ANOVA. SPSS 22.0 Windows version package program was employed for the analyses. $P<0.05$ was considered statistically significant.

RESULTS

Study Population

In our study, 56 infants born prematurely in 2020 were enrolled. The participants were divided into two equal groups based on the education models provided to their mothers. Throughout the study, a total of 5 children who did not participate were excluded. Three children from Group 1, receiving visual and verbal education, and two children from Group 2, receiving only verbal education, were excluded from the study.

Demographic data about the mother's educational level and family income for the participant infants and their parents are presented in Table 1. Statistical analysis revealed no significant differences in demographic variables between the two groups.

The gender distribution of the infants included in the study is shown in Table 1, and there was no statistically significant difference in gender distribution.

The Plaque Index and Caries Index of mothers are presented in Table 1. Statistical analysis revealed no significant difference between the plaque index and caries index data of mothers in the two groups.

Table 1- *Demographic Characteristics and Decayed (D), Missing (M), and Filled (F) Tooth (DMFT) and Plaque Index in Mothers' of Two Groups*

	Groups

		Visual and Verbal Education		Verbal Education		
		n	%	n	%	p
Gender	Girl	18	64,3	13	46,4	0,179
	Boy	10	35,7	15	53,6	
Birth Method	Normal	11	39,3	6	21,4	0,146
	Caesarean	17	60,7	22	78,6	
Mother's Education	Primary School	13	46,4	11	39,3	0,401
	High School	13	46,4	11	39,3	
	University	2	7,1	6	21,4	
Working Mother	Yes	2	7,1	3	10,7	0,638
	No	26	92,9	25	89,3	
Working Father	Yes	27	96,4	26	92,9	0,549
	No	1	3,6	2	7,1	
Smoking Father	Yes	3	10,7	9	32,1	0,051
	No	25	89,3	19	67,9	
Smoking Mother	Yes	16	57,1	20	71,4	0,265
	No	12	42,9	8	28,6	
Family Income	Below Minimum Wage	3	10,7	4	14,3	0,699
	Minimum Wage	13	46,4	15	53,6	
	Above Minimum Wage	12	42,9	9	32,1	

Mother's PI	1	14	50	13	60,7	0,420
	0	14	50	11	39,3	
Mother's DMFT	0	4	14,3	2	7,1	0,383
	>0	24	85,7	26	92,9	

**Significant at p < 0.05 level, Chi-square test*

Data on the dietary and brushing habits for infants in the two training groups are presented in Table 2. The habit of consuming water after feeding was significantly higher (p=0,025) in infants in Group 2 compared to infants in group 1.

The oral hygiene assessment for the two training groups is presented in Table 2. No significant difference was found in tooth brushing habits between the two groups. All parents who received education in both models brush their children's teeth.

***Table 2**- Comparison of dental caries, dietary and brushing habits of infants in two training groups at last control*

		Groups		
		Visual and Verbal Education	Verbal Education	
		n (%)	n (%)	p
Caries 9 Months After the Last Visit	Ct>0	4 (16)	3 (11,5)	0,647
	Ct=0	21 (84)	23 (88,5)	
Nighttime Feeding After 12 Months	Yes	10 (40)	7 (26,9)	0,322
	No	15 (60)	19 (73,1)	
Water After Feeding	Yes	14 (56)	22 (84,6)	0,025*
	No	11 (44)	4 (15,4)	
Antibiotics Usage	Yes	13 (52)	9 (34,6)	0,210
	No	12 (48)	17 (65,4)	

Tooth Brushing	Yes	25 (100)	26 (100)	-
	No	0 (0)	0 (0)	
Brushing Habit	Once a day	0 (0)	0 (0)	0,843
	Twice a day	17 (68)	17 (65,4)	
	Not regular	8 (32)	9 (34,6)	

*Significant at $p < 0.05$ level, Chi-square test

Dental Caries and Dental Plaque Assessment

The oral hygiene and dental caries assessments for the two groups during follow-up appointments are presented in Table 3. No cavities were observed in either group at initial assessments. At the end of our study, 22 out of 25 infants in Group 1 and 24 out of 26 infants in Group 2 had completely caries-free. The plaque index data for both groups are presented in Table 3.

Table 3 *–Distribution of Dental Caries and Plaque Index Scores of Infants During Control Follow-ups*

	Groups									
	Visual and Verbal Education					Verbal Education				
	Caries free	Caries with initial lesions	Caries with cavitated lesions	PI 0	PI 1	Caries free	Caries with initial lesions	Caries with cavitated lesions	PI 0	PI 1
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Baseline	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
3rdMonth	0(0)	1(50)	1(50)	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
6thMonth	9(75)	2(16,7)	1(8,3)	12(100)	0(0)	8(89)	1(11)	0(0)	8(100)	0(0)
9thMonth	20(87)	2(8,7)	1(4,3)	19(82,6)	4(17,4)	21(91,3)	2(8,7)	0(0)	20(87)	3(13)

12thMonth	22(88)	2(8)	1(4)	23(92)	2(8)	21(87,5)	3(12,5)	0(0)	19(79,2)	5(20,8)
15thMonth	22(88)	1(4)	2(8)	23(92)	2(8)	23(88,5)	3(11,5)	0(0)	24(92,3)	2(7,7)
18thMonth	21(84)	1(4)	3(12)	20(80)	5(20)	23(88,5)	3(11,5)	0(0)	25(96,2)	1(3,8)
9 Months After the Last Control	21(84)	2(8)	2(8)	23(92)	5(20)	23(88,5)	3(11,5)	0(0)	20(87)	3(13)

Knowledge Assessment

The pre-test and post-test results for the two groups' mothers are shown in Table 4. Initially, there was no significant difference in the pre-test scores There was no significant difference (p=0,322) in pre-test and post-test values between the two groups. However, both education models demonstrated a statistically significant (p=0,001) impact on the knowledge level.

Table 4 *– Knowledge Levels of Between the Mothers of The Two Training Groups*

	Pre-test	Post-test	
	Mean±SD	Mean±SD	p
Visual and Verbal Education	3,07 ± 1,15	5,12 ± 0,67	0,322ǂǂ
Verbal Education	3,18 ± 1,16	5,38 ± 0,75	
p	0,001*†		0,811‡

***** Significant at p < 0.05 level, Two-way repeated measures ANOVA

ǂǂBetween groups, †Within subjects, ‡Group*Measurement interaction

DISCUSSION

The main purpose of our study is to examine the effect of two different education models to given mothers on the development of dental caries in preterm infants.

It has been shown that preterm infants are prone to ECC (Boustedt et al., 2020; Sridevi et al., 2018a; Twetman et al., 2020). ECC is a multifactorial disease, such as maternal education level, family income level, maternal smoking habits, and maternal caries have been shown to be predisposing factors for ECC. (Foxman et al., 2023; Sankeshwari et al., 2013). A previous study has been shown that maternal education level and the presence of caries increase the risk of ECC (Sridevi et al., 2018b). The study by Goto et al., (2019) also found an association between active parental smoking and ECC in children (Goto et al., 2019). In our study, based on the demographic data collected from the parents, there was no significant difference between the two groups. Similarly, there was no significant difference between the two groups in terms of maternal oral hygiene.

Insufficient knowledge of oral and dental health in parents has been associated with children having a high prevalence of dental caries (Khodadadi et al., 2016). Studies have shown that the mothers of newborn babies do not have sufficient knowledge about infant oral health (Jaafar and Badr, 2018; Hallas et al., 2015b). Similarly, in our study, we observed a lack of knowledge in the pre-tests conducted on mothers before the education sessions.

There are many studies in the literature that use different educational models for parents. The simplest educational method that comes to mind is verbal education (Theis and Johnson, 1995). Audio recordings and video recordings can be used in digital environments for parental education (Gysels and Higginson, 2007; Santo et al., 2005). Oral hygiene education can be effectively provided to mothers with the support of videos or publications using technology. These education sessions can be provided as routine postpartum briefings in postnatal rooms or by nurses (Hallas et al., 2015b). Studies have found that parents frequently use their phones to access information about child health (Dienelt et al., 2020). However, the limitation in this regard is families who may not want to install a mobile application and families who do not have access to a smartphone, albeit limited, to install a mobile application (Uribe et al., 2021).

In studies, verbal education and information sessions are the easiest to forget and the least effective when provided alone and in a single session (Theis & Johnson, 1995). Based on the study, written education will always maintain its importance alongside verbal explanations due to the strength of direct interaction. Written information in addition to verbal explanations will serve as a reminder and enhance retention (Johnson and Sandford, 2005b). In contrast, in our study, although infants in the group receiving verbal education developed fewer caries, no significant difference was found between the two groups. In our study, repetitions were three-month interval. We think frequent repetition could be affected.

The American Academy of Pediatric Dentistry (AAPD) recommends the guidance process called “Anticipatory Guidance” for educating parents about their children's oral and dental

health. This process helps parents better understand their children's development and provides them with better support. Dentists can also play a role in this process by providing parents with information and advice on their children's oral and dental health. This guidance process begins during pregnancy and continues with regular check-ups. The first examination and education should start after the eruption of the first tooth and continue every 6 months (American Academy of Pediatric Dentistry, 2023). Several studies have been showed that parents' training needs to be repeated at least every 6 months (Kader et al., 2015; Meyer et al., 2014)

Given instructions starting during the pregnancy and after birth six months check-up conducted by Meyer et al., (2014), as outlined in their study, resulted in a significant improvement in the oral health of both mothers and children. After the eruption of first teeth, education given to mothers was shown to be effective, there was no difference between visit every 3 months or every 12 months (Kowash et al., 2000).

In a study by Siqueira et al. (2010), interventions every three months which contains examination, fluoride application and given verbal instructions to mothers was successful in maintaining oral health, keeping children caries-free, and controlling white spot lesions (Siqueira et al., 2010). In our study, we identified five children with white spot lesions; however, we were able to maintain four of them as caries-free. The application of fluoride to white spot lesions may have contributed to the difference. In our study children didn't have any fluoride applications during follow-ups.

In our study, in the post-tests conducted after the educational sessions among the study groups, a significant increase in maternal knowledge was observed in both groups. However, there was no statistically significant difference between the two groups. This indicates that both educational models are effective in increasing maternal awareness and awareness of their children's oral health.

Considering these data, we can observe that the education provided significantly increases the knowledge level of mothers. Our study particularly demonstrates that verbal education alone can be sufficient when repeated frequently.

CONCLUSION

In conclusion, our study demonstrates the effectiveness of both verbal and visual educational models in increasing maternal awareness about oral and dental health in preterm infants. The absence of significant demographic differences between the two groups at the study strengthens the internal validity of our results.

The significant increase in maternal knowledge in both groups during post-tests further underscores the positive impact of the education provided. The choice of educational model, whether verbal or visual, did not yield a statistically significant difference in preventing dental

caries. This suggests the potential effectiveness of repeated verbal education sessions, providing flexibility in resource allocation. The success of interventions every three months aligns with existing literature. Future research may explore larger cohorts and long-term impacts to further enhance our understanding of preventive measures against ECC in preterm infants.

Informed consent: For this type of study, formal consent is required. Informed consent was obtained from all individual participants included in the study.

Conflict of interest: The authors declare no competing interests.

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