Evaluation of the Effect of Maternal Education on Toddler Dental Plaque Removal Based on a Health Belief Model

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Article Info	A B S T R A C T
Article type: Original Article	**Objectives:** The objective of this study was to investigate the impact of an educational intervention, guided by the Health Belief Model (HBM), on promoting preventive behaviors among mothers to combat early childhood caries (ECC) in toddlers aged 12 to 18 months.
	Materials and Methods: This single-blind interventional study evaluated 92 toddlers between 12 to 18 months and their mothers, who were selected by stratified random sampling. Data regarding demographic and nutritional factors were collected using a questionnaire. The dental status of children was evaluated by clinical examination and measuring the plaque index (PI) of maxillary central incisors and the dmfs index. A pamphlet designed according to the HBM was used for oral hygiene instruction in both the intervention and control groups. All of the mothers in the intervention group received a music file to listen to when brushing their children's teeth. Data were analyzed using chi-square, Fisher exact, Mann-Whitney, and Wilcoxson tests. P<0.05 was considered significant.
* Corresponding author: Department of Pediatric Dentistry, School of Dentistry, Birjand University of Medical Sciences, Birjand, Iran Email: charmeha961@mums.ac.ir	**Results:** No significant correlation was noted between the daily frequency of sugary substance intake and primary PI in the intervention or control group with/without dental plaque (P>0.05). In the intervention group, PI significantly decreased after the intervention compared to baseline (P<0.001). However, there was no significant change in PI after the intervention in the control group compared with baseline (P=0.1).
	Conclusion: The findings indicate that a combination of educational intervention and incentives, such as using age-appropriate music for toddlers, can significantly enhance mothers' effectiveness in removing dental plaque.

INTRODUCTION

Early childhood caries (ECC) is among the most common chronic infectious diseases of childhood. ECC may be associated with pain during mastication or sucking, impaired function of mastication, growth retardation, and iron deficiency [1], which can all decrease the quality of life of children [2]. The related risk factors include long-term bottle-feeding, poor oral hygiene, low level of fluoride in the nutritional regimen of the child, and poor knowledge level of the parents about oral healthcare [3]. Some other suggested risk factors include inappropriate nutritional regimen (high sugar content, poor nutritional habits, nocturnal breastfeeding),

environmental factors (premature birth, low birth weight, low level of education of the parents, and poor socioeconomic status), patient-related factors (mother's oral hygiene, child's oral hygiene, quality of saliva), and tooth-related factors (inadequate fluoride intake, genetic factors, enamel defects) [4]. Although dental caries is not life-threatening, it is a matter of great concern in dental public health because of its high prevalence in some developing countries [5,6].

ECC is a health dilemma in both developing and some developed countries. The treatment cost is high especially for patients who need to be hospitalized and undergo general anesthesia for extensive restorations. Thus, prevention of ECC is a priority. Our country, Iran, has a relatively young population, and oral health promotion is a challenging topic in Iran.

Iran lies in the category of countries with intermediate levels of caries prevalence according to dmft and DMFT values among various age groups; the high numbers of decayed teeth in the Iranian population is alarming [7]. About 84.3% of 5–6-year-old children were reported to be in need of treatment for dental caries experience [8]. The cost-effectiveness of curative and restorative approaches are not suitable in most countries [7].

Shifting the treatment-based approach to prevention-based approach is not possible without involving the community. Efficient dentist-patient communication plays a fundamental role in this respect [9]. Healthy behaviors by the parents and caring for oral health promotion of their children can improve the oral health of children. Promotion of healthy behaviors in accordance with health behavior models that have a theoretical base is often more successful.

This study was conducted according to the health belief model (HBM), which comprises of 4 beliefs as theoretical constructs: perceived susceptibility of a disease or its risk, perceived severity of disease, perceived barriers and benefits of adopting a healthy behavior. in addition the resources through which, one acquires health information [10] are important. The HBM is one of the commonly used health theories for oral health behavior [11]. Multiple studies have shown significant effects of parental beliefs on the teeth brushing behavior of their children [12,13]. An international study conducted in 17 countries showed parental belief about tooth brushing was associated with twice-daily tooth brushing for their children aged between 3 to 4 years [12]. However, for young children under 2 years old, evidence about importance of the parental beliefs about oral hygiene behavior of their children, is extremely limited.

The aim of this study was to assess the efficacy of an educational intervention, guided by the Health Belief Model (HBM), on promoting preventive behaviors among mothers to combat early childhood caries (ECC) in 12-to-18-month toddlers.

MATERIALS AND METHODS

Present study was approved in the ethic committee of Mashhad University of Medical Sciences (code 900989)

In this pilot interventional study, we evaluated 92 child-mother pairs. The formula for calculating the sample size is as follows (β=0.2, α=0.05):

$$n = \frac{(s_1^2 - s_2^2)(z_{1-\frac{\alpha}{2}}^2 + z_{1-\beta}^2)}{(\mu_2 - \mu_1)^2}$$

Toddlers were selected from 12 to 18-month-old children attending 10 kindergartens in Mashhad city using the three-stage cluster sampling method. On average 9 children were selected from each kindergarten. Stage 1 consisted of selecting one of the seven education districts in the city, which was followed by stage 2, during which 10 kindergartens were chosen out of the 47 kindergartens in that district. In the final third stage, 9 eligible toddlers were selected in each kindergarten utilizing the non-random sampling method. The list of random numbers with block randomization method was obtained from "www.randomizer.org" by a researcher not involved either the clinical examination or interviewing of participants. The number and name of the intervention (pamphlet or pamphlet with music file) was

written on a sheet of paper and put inside sealed and opaque envelopes. In the kindergarten, envelopes were opened by the kindergarten manager and the toddlers were assigned to each study group, randomly. Following a thorough briefing, mothers who expressed willingness to participate in the study and possessed cell phones equipped with Bluetooth wireless technology for music file reception, were enrolled.

All mothers signed informed consent forms prior to their participation. Next, the mothers were asked about their children's demographic information including their gender, date of birth, order of child in the family, and some other factors such as the mother and father's level of education, and socioeconomic status of the family. Subsequently, a questionnaire was filled out by the mothers regarding iron drop consumption and the daily nutritional regimen of their children, daily intake of sugary substances, nocturnal feeding and its frequency, and duration of bottle-feeding. Also, the mothers were required to provide information about the oral hygiene behavior of themselves and their children, frequency of toothbrushing for the child, oral hygiene tools used for cleaning their child's teeth, and the person who performed tooth cleaning for the child.

After the initial phase, oral hygiene variables such as plaque index (PI) of maxillary central incisors before and after the educational intervention, and dental caries based on the dmfs index before and 6 months after the intervention were recorded for both groups. A total of 80 children were re-examined and six children were lost to follow up in each study group for different reasons. The most common reasons were non-responsiveness to phone calls, relocation to another kindergarten during the study period, or unwillingness of the parents to remain in the study.

All clinical dental examination of the children was performed by the help of the mothers through lap-to-lap examination in a well-lit room using a dental mirror and a flashlight. PI and dmfts were recorded in a checklist. All clinical oral examinations were performed by

one of the authors (PS). The reliability of the study outcome measurements was confirmed in toddlers using two oral examinations with a one-week interval. According to the PI, the children were categorized into three categories including absence of dental plaque, gingival marginal plaque, and abundant dental plaque.

Mothers were instructed on preventive measures for caries control in their children and received an educational pamphlet designed according to the HBM.

In terms of perceived susceptibility, mothers were convinced that neglecting to brush their child's teeth could lead to early-age tooth decay. Regarding perceived severity, mothers were convinced of the potential consequences of dental caries resulting from subpar oral hygiene, including issues such as pain, sleep disturbances, dental infections, compromised teeth appearance, and the need for dental treatment under general anesthesia. As for perceived benefits, mothers were convinced that regular tooth brushing could mitigate the risk of dental caries, possibly preventing it altogether. Conversely, within the realm of perceived barriers, mothers anticipated potential downsides to tooth brushing, such as exertion and fatigue.

At the end of the session, the kindergarten manager transferred a music file to the smartphones of some randomly selected mothers in the intervention group via Bluetooth and also handed them the CD of the music file and they were requested to play the music every night when brushing their child's teeth.

The duration of follow-up was six months. The mothers were contacted by phone on a monthly basis to emphasize the significance of caries preventive measures. After six months, the examiner presented to the kindergartens again with no prior notice and clinically examined the children to determine their secondary dmfs and PIs as described earlier. Figure 1 shows the study flowchart.

The data was analyzed using chi-square, Fisher exact, Mann-Whitney, and Wilcoxson tests. P<0.05 was considered significant.
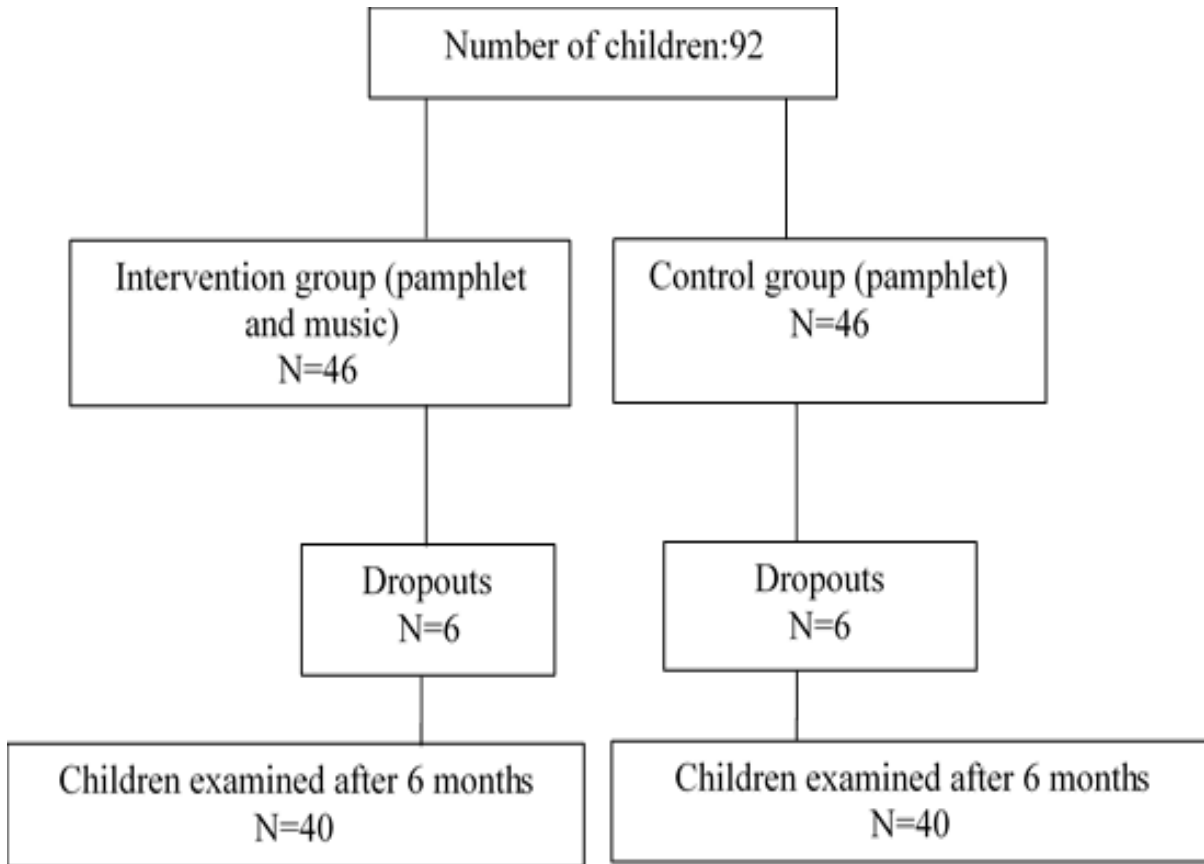
Fig. 1. Study flowchart

RESULTS

The prevalence of ECC was found to be 8.75% in our study population. Table 1 compares the demographic variables between the intervention and control groups at baseline. As demonstrated in this table, the two groups were not significantly different regarding demographic variables at baseline (P>0.05).

Nutritional variables such as the use of iron drop, child's daily nutritional regimen, frequency of daily intake of sugary substances, nocturnal feeding and its frequency, and duration of bottle-feeding (in months) were compared between the two groups at baseline.

As shown in Table 2, the two groups were not significantly different regarding the nutritional variables. The Mann-Whitney test showed no significant difference in the duration of bottle-feeding (in months) between the intervention and control groups at baseline (P=0.95).

Table 3 shows the PI of maxillary central incisors in the two groups at baseline while Table 4 demonstrates the PI of maxillary central incisors in the two groups after the intervention. The Mann-Whitney test revealed no significant difference between the two groups regarding the PI of maxillary central incisors neither at baseline (P=0.14) nor after the intervention (P=0.93). The Wilcoxon test was applied to compare the primary (Table 3) and secondary (Table 4) PI in each group. The results showed that the secondary PI in the intervention group had significantly decreased compared with the baseline PI (P=0.001).

The frequency of very satisfied and satisfied mothers with their improved capability in cleaning their child's teeth after the intervention was found to be 81%.

Table 1. Demographic variables in the intervention and control groups at baseline

Groups Variables		Control	Intervention	P
Mean age (months)		15.05±2.85	15.85±2.1	0.13
Gender (%)	Female	18(45%)	20(50%)	0.65
	Male	22(55%)	20(50%)	
Order of child in the family (%)	First	24(60%)	24(60%)	0.92
	Other	16(40%)	16(40%)	
Mother's level of education (%)	High-school diploma or lower	22(55%)	19(47.5%)	0.5
	Higher than high school diploma	18(45%)	21(52.5%)	
Father's level of education (%)	High-school diploma or lower	18(45%)	37.5(15%)	0.49
	Higher than high school diploma	22(55%)	25(62.5%)	

Table 2. Comparison of nutritional variables between the intervention and control groups at baseline

Variables N(%)		Control	Intervention	P
Iron drop consumption	Yes	26(65)	32(80)	0.13
	No	14(35)	8(20)	
Drink used after consumption of iron drop	Water	19(47.5)	23(57.5)	0.37
	Sweet drinks	2(5)	3(7.5)	
	None	19(47.5)	14(35)	
Daily frequency of sugary substance intake	Never or maximally once	24(60)	11(27.5)	0.07
	Twice	1(2.5)	7(17.5)	
	More than twice	15(37.5)	22(55)	
Drink consumed at night	Nothing or water	8(20)	4(10	0.44
	Breast milk	26(65)	30(75)	
	Formula	6(15)	5(15)	
Frequency of nocturnal feeding	None	8(20)	5(12.5)	0.26
	Once	4(10)	8(20)	
	Twice	12(30)	11(27.5)	
	More than twice	16(40)	16(40)	

Table 3. Comparison of PI of maxillary central incisors between the intervention and control groups at baseline

Groups (N=40, each)	Baseline PI of maxillary central incisors N(%)					
	No plaque		Gingival marginal plaque		Abundant plaque	
Intervention	0.2	35	11	27.5	15	37.5
Control	19	47.5	11	27.5	10	25

Table 4. Comparison of PI of maxillary central incisors between the intervention and control groups after intervention

Groups (N=40, each)	PI of maxillary central incisors after intervention N(%)					
	No plaque		Gingival marginal plaque		Abundant plaque	
Intervention	23	57.5	13	32.5	4	10
Control	23	57.5	12	30	5	12.5

DISCUSSION

Considering the high prevalence of ECC in Iranian children [14] this study aimed to identify and assess the risk factors related to ECC such as age, gender, birth order, level of education of the parents, socioeconomic status of the family, daily nutritional regimen of the child, daily frequency of intake of sugary foods, nocturnal feeding, duration of nocturnal bottle-feeding (in months), consumption of iron drop, and frequency of tooth cleaning in children. The children were between 12 to 18 months. This study also assessed the effect of oral hygiene instruction via an educational intervention according to the HBM on preventive behavior of mothers for prevention of ECC.

Considering the optimal efficacy of plaque removal by toothbrushing and decreasing the risk of caries [15] especially in children under two years of age with frequent intake of sugary substances, and physical and psychological inability of the child for plaque removal, cooperation of mothers is imperative in this respect. Thus, the parents should attempt to establish toothbrushing as a favorable habit and create a happy environment (for example by playing music) to make it a favorable experience for the child [15].

This study used the HBM to impact the beliefs of mothers and confirmed the optimal efficacy of this model for oral health promotion. In line with our findings, Ramezankhani et al. [16] found a significant correlation between DMFT and belief in oral hygiene instruction of fifth graders in Dezful city. Their educational intervention enhanced the toothbrushing behavior of students and decreased their rate of caries. Our study confirmed the efficacy of the HBM, which was in agreement with the results of Shamsi et al, [17] who confirmed the efficacy of this model for oral health promotion. Hazavei et al. [10] evaluated the oral health status of middle schoolers and assessed the efficacy of an educational intervention based on the HBM and behavioral theories to enhance their knowledge and improve their behavior regarding caries prevention and oral health promotion and confirmed its efficacy. The current

randomized clinical trial showed that educational intervention designed according to the HBM effectively decreased the PI of children in the intervention group especially those who had received the music file. Our results were in agreement with Hajimiri et al, [18] who reported that enhancement of oral hygiene knowledge of mothers according to the HBM improved the oral hygiene and caries preventive behaviors in their children.

In the present study, no significant difference was noted between the intervention and control groups in any variable at baseline. After the intervention, improvement in indices was observed in both groups; however, this improvement was greater in the intervention group. Our results were in agreement with those of Solhi et al, [19] since they showed, a significant correlation between the perceived susceptibility and skills of toothbrushing and dental flossing.

In order to obtain the best results with regard to improvement of PI, in addition to instruction of correct toothbrushing technique to mothers, playing music can attract the attention of children and increase their tolerance during toothbrushing performed by the mother. We requested the mothers to brush their child's teeth for two minutes after the music started to play. Thus, the children's teeth were brushed by the mothers twice daily each time for two minutes.

Our results regarding improvement of PI were in line with those of Ganesh et al [15], who reported improvement of PI following the use of a musical toothbrush compared with a conventional toothbrush, because the duration of toothbrushing and the tolerance of children increased in the musical toothbrush group. Also, Subburaman et al [20] reported a significant reduction in debris index in the musical toothbrush group. Music playing in the background during toothbrushing is motivating and the children gradually memorize the song and repeat it during the day. They may even fall asleep while rehearsing it after toothbrushing.

This study had a single-blind design to decrease examiner error, and the main examiner was not aware of the group

allocation of the toddlers and mothers.

According to the results, oral hygiene instruction based on the HBM was useful for the significant change in preventive behavior of mothers and enhancement of their knowledge regarding the significance of toothbrushing for their children because over time, the children of mothers in both groups became acquainted with this healthy behavior as the result of their mothers' attempts.

Toothbrushing is the main measure for plaque removal and prevention of ECC in children [15]. It should be noted that the optimal efficacy of music playing while toothbrushing may be short-term as concluded by Jacobson et al, [21] in their study on the efficacy of a mobile application for improvement of toothbrushing behavior of 5 to 6-year-olds.

CONCLUSION

Educational intervention according to the HBM along with music playing was more effective for reduction of PI in 12 to 18-month-old children compared with educational intervention based on the HBM without music playing.

CONFLICT OF INTEREST STATEMENT

None declared.

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