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Planning, implementation, and evaluation of educational intervention based on PRECEDE–PROCEED model for mothers about oral health promotion on children aged 3–6 years

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Abstract:

BACKGROUND: Mothers play an important role in oral health of children. The present study was planned, implemented, and evaluated to determine the impact of mothers' educational program based on PRECEDE–PROCEED model on oral health promotion of Rafsanjan 3–6-year-old children, in 2020.

MATERIALS AND METHODS: This quasi-experimental study was conducted on 100 mothers with children aged 3–6 years divided into two groups. The research tool was developed and approved based on the model phases in the form of demographic information, predisposing, enabling, and reinforcing factors. At phase five, intervention planning was conducted and the program was implemented in four sessions (45 min each) in 30 days. Follow-up was done 2 months after the last training session. The data were analyzed by SPSS18, using Chi-square, paired *t*-test, and independent *t*-test at the significance level of 0.05.

RESULTS: After implementing the program, a significant difference was observed between predisposing, enabling, and reinforcing factors, as well as oral health-related behaviors of the two groups ($P < 0.05$). Finally, 30.4% of the changes in oral health-related behavior resulted from the implementation of the designed educational program.

CONCLUSION: Considering the importance of planning to promote children's oral health and hygiene, it is recommended that the PRECEDE–PROCEED model be used to design, implement, and evaluate health evidence-based interventions.

Keywords:

Child, educational, mothers, oral health, PRECEDE–PROCEED model, preschool

Introduction

Oral health has a considerable impact on the general health and quality of life (QoL) of individuals and their families.^[1] About 99% of people have experienced tooth decay in their lifetime and 37% of tooth loss is due to caries.^[2] Caries is a very common disease in children that can result in various limitations and complications in their everyday performance.^[3] The prevalence of

caries in baby teeth is 59% among 5-year-old Indian children.^[4] Among Iranian children, the rate of caries is 62.8% in baby teeth, and 78.6% in permanent teeth.^[5] Poor oral health reduces the QoL^[6] and brings about nutritional problems, low self-esteem and stunted growth,^[7] stroke, respiratory problems, laryngeal cancer, diabetes,^[8] as well as absenteeism, and academic failure.^[9]

In general, the factors affecting oral health can be categorized into two groups:

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behavioral factors such as low knowledge, unfavorable attitude toward oral health, consume sugar and sweets, obesity, lack of cooperation and having no time for oral health care, having parents that brush teeth less than twice a day, parents' inability to control their children's brushing habits,^[10,11] low self-efficacy and, fear of treatment, do not brushing and flossing teeth, do not visit the dentist regularly twice a year, eating unhealthy foods, and eating junk food^[9,12,13] and nonbehavioral factors such as reduce the amount of fluoride in drinking water, poor socioeconomic status, high costs of health care, lack of access to oral health services.^[12,13]

Preschool children lack the necessary cognitive and functional skills to maintain optimal oral health; hence, their mothers are responsible for their dental care.^[14] Due to low knowledge of parents and caregivers about the importance of children's oral health,^[15] it is vital to provide them with education as a strategy to prevent oral diseases and for the education to exert positive and beneficial effects, it should be principled, be based on models of behavior change, and have a theoretical basis.^[16]

Theories and models equip us with a systematic perspective on events or situations, are in the form of a scheduled process for analyzing failures or successes, and provide the necessary guidelines for educational examination and diagnosis, planning, designing, and evaluating the educational interventions.^[16] In the meantime, PRECEDE–PROCEED model is a framework and design model to identify the needs in health education and health promotion. It is also a process for behavior change, examining the possible outcomes of an educational program. Green and Kreuter (2005) argued that the hallmarks of PRECEDE–PROCEED model include flexibility, scalability, evaluability, commitment to the principle of participation, and having a process structure. PRECEDE–PROCEED model provides a framework by which predisposing factors (knowledge, attitudes, perceptions, beliefs, etc.), reinforcing factors (influence of others, family members, peers, and health workers), and enabling factors (availability of resources and skills) are determined as factors affecting behavior in educational diagnosis. In fact, the most beneficial application of the model is explaining the behavior-related factors.^[16] Studies by Hajimiri *et al.*^[17] and Shirzad *et al.*^[18] showed that after the educational intervention, oral health improved compared to the preintervention stage. Moreover, it has been approved that this model might also be used to design, implement, and evaluate oral health intervention of students aged 7–12 years.^[19] Considering the key role of mothers in promoting children's oral health, the present study was designed and conducted based on PRECEDE–PROCEED theory, aiming to empower mothers with regard to their children's oral health-promoting behaviors.

Materials and Methods

Study design and setting

This quasi-experimental study, pre–post intervention, with a control group, was conducted in 2019–2020, and its planning, implementation, and evaluation took 14 months in Rafsanjan.

Study participants and sampling

The study was conducted on 100 mothers with children aged 3–6 years divided into two groups. The sampling method was random cluster. Eight health centers in Rafsanjan were considered clusters. Due to the lack of zoning in Rafsanjan, the centers were marked on the map and the map was divided into north and south. Then, two centers were selected randomly from each area and divided into control and intervention groups randomly. Finally, we selected an intervention and control group in each area.

In accordance with a similar study,^[17] using the equation $n = \frac{2(Z_{1-\alpha/2} + Z_{1-\beta})^2 \sigma^2}{d^2}$, the required sample size was calculated to be 45 mothers in each group. However, at the end, the size of each group was determined to contain 50 participants due to a 10% probability of participant attrition.

In the health centers, random sampling was done based on the household number registered in Health Integrated System, and mothers of 3–6-year-old children were randomly sampled. Phone calls were used to invite the mothers to participate in the research. The inclusion criteria were the mother's minimum literacy to read and write, and her interest and consent to participate in the study. On the other hand, the exclusion criteria included absence for more than two sessions during the educational intervention and not completing the posttest.

Given the nature of model planning, the following measures were taken to develop an evidence-based intervention plan in accordance with model phases one to four.

In the social diagnosis phase, the studies and group discussions with 7 mothers of 3–6-year-old children confirmed the impact of ignoring oral health-related behaviors on different aspects of child and family life, that is, physical (pain, learning disabilities, sleep disorders, and speech), psychological (decreased self-confidence and self-esteem, feelings of shame, and anxiety), and social aspects (absenteeism from school, disruption of social relations, and life affairs).^[20-26] Previous studies have shown,^[27] Decayed, Missing, and Filled Teeth (DMFT) index is used as a key and epidemiological index in oral health programs.

According to the Oral Health Department of Rafsanjan University of Medical Sciences informal reports, the mean DMFT index is 1.84 and dmft for baby teeth is 1.49.

In the behavioral and environmental diagnosis phase, first, based on the studies^[19,28-30] as well as the results of group discussions with mothers, behavioral factors (toothbrushing, flossing, using fluoride toothpastes, consuming dairy products, and reducing consumption of sugars and parents' education) and nonbehavioral factors (fluoridated drinking water, chronic and underlying diseases, and socioeconomic status) affecting oral health were identified. Then, behavioral factors in the decision-making matrix, with two criteria of importance and variability, were sent to ten oral health specialists to identify the most important behavioral factor of first priority, which affects the oral health. Accordingly, the brushing and flossing behavior gained the highest score and was identified as the most important behavioral factor affecting oral health.

In the educational and ecological diagnosis phase, based on the studies^[18,19,31,32] and group discussions with mothers and oral health specialists, the constructs of knowledge, attitude, perceived threat, perceived benefits, and self-efficacy of parents were identified as predisposing factors; the constructs of perceived barriers and perceived behavioral control of parents were identified as enabling factors, and constructs of family support and reinforcement were identified as reinforcing factors. These factors were considered as research tools in the form of predisposing, enabling, and reinforcing constructs.

Data collection tool and technique

A questionnaire was designed covering the following items: demographic characteristics (age of parents and children, education and occupation of parents, and family income); predisposing factors including 11 questions on oral health-related knowledge with response scales of four-choice and three-choice yes-no-don't know options, and scores ranging from 0 to 46 (for example: When should one start maintaining oral health?); 6 questions on attitude, 8 questions about perceived threats, 10 questions on perceived benefits, and 7 self-efficacy questions with scores ranging from 6-30, 8-40, 10-50, 7-35; enabling factors including six questions on perceived barriers and four questions concerning perceived behavioral control with scores ranging from 6-30, 4-20; and reinforcing factors construct including eight questions about family support, and four family reinforcement questions with scores ranging from 8 to 40, 4-20. The response scale was based on a Likert scale from "Definitely Agree" to "Definitely Disagree," and "I can definitely do it" to "I can't do it at all."

Behavior consisted of six questions with scores ranging from 6 to 30 and on a scale from "Never" to "Always" (for example, my child brushes teeth after eating sweets). Nine health education and health promotion specialists and dentists confirmed the validity of the questionnaire using content validity index and content validity ratio indexes. The reliability of the questionnaire was examined using test-retest method with the cooperation of 10 mothers of 3-6-year-old children for 14 days, and the correlation coefficient of all constructs proved to be higher than 0.9. Hence, its reliability was also confirmed.

After obtaining informed consent, and explaining research objectives and expectations, the mothers in both groups completed the pretest. Based on Phase 4 "administrative and policy assessment and intervention alignment," first, we analyzed the pretest, reviewed the frequency of responses, and listed training priorities, then the educational strategies were identified, we went to the schools in coordination with the educational department, the educational environment was visited, and after taking the initial steps, the lesson plan was written. Interventional program was designed in four sessions of 45 min over 30 days [Table 1]. Due to the pandemic of coronavirus disease, the participants were distributed into groups of 5-6 people, and the program was performed in collaboration with mothers with strict observance of health protocols in the intervention group, using various methods of lectures, group discussions, questions and answers, demonstrations, and using moulage, pictures, and video clips. At the end, they were given children's toothbrushes, toothpastes, pamphlets, and educational booklets. Furthermore, to have a sustained learning, a virtual group was formed on WhatsApp, where the intervention group had access to all educational materials. Two months after the last session of the educational intervention, both groups completed the posttest. Then, the data were analyzed by SPSS-18 software (for Windows; SPSS Inc., Chicago, IL, USA) using independent *t*-test, paired *t*-test, and Chi-square after checking the normality status. The significance level in the tests was considered 0.05.

Ethical consideration

For ethical considerations, a training session was held in which the mothers in the control group were provided with an educational pamphlet.

Results

The average age of all mothers was equal to 34.00 ± 5.06 years (intervention group = 33.84 ± 5.91 and control group = 34.16 ± 4.21 y) and the mean age of children was 4.72 ± 1.06 years. In the present research, 16% of children were 3 years old, 26% were 4 years old, 28% were 5 years old, and 30% were 6 years old. About

Table 1: Lesson plan of educational sessions conducted for mothers regarding children’s oral health

Sessions	Goal	Objectives	Learning domain	Methods and media and teaching aids
1	Improving mother’s knowledge	Definition of oral health, dental function, signs, and symptoms of caries, characteristics of toothbrush and appropriate toothpaste	Cognitive	Lectures, Q and A, computer and data show and tooth modeling
2	Increasing the perceived threat of mothers	The importance of oral health, the consequences of noncompliance with oral health, and its impact on quality of life in various dimensions	Cognitive affective	Lectures, Q and A, computer and data show, pictures and video training
3	Promote perceived benefits and remove perceived barriers	Refer to studies on the positive outcomes of oral health (physical, mental, social and .) Efforts to remove perceived behavioral barriers	Affective	Group discussion, computer, and data show
4	Promoting self-efficacy and perceived behavioral control	Learn to brush properly Proper use of toothpaste and floss	Psychomotor	Demonstration and tooth modeling

61% of 3–6-year-old children were girls and 39% were boys. There was no statistically significant difference between the age of children and the age of mothers in the two groups ($P = 0.190$, $t = -1/320$), ($P = 0.724$, $t = 0.354$). In addition, no significant differences were seen between the parents’ educational level ($P = 0.485$, $\chi^2 = 2.44$), occupation of parents ($P = 0.517$, $\chi^2 = 0.421$), and family income in the two groups ($P = 0.139$, $\chi^2 = 3.94$).

After the intervention was performed, significant increase was observed between the intervention and control groups in the mean scores of the constructs of PRECEDE–PROCEED model, namely knowledge ($P < 0.001$), attitude ($P < 0.001$), perceived threat ($P < 0.001$), perceived benefits ($P < 0.001$), perceived barriers ($P < 0.001$), self-efficacy ($P < 0.001$), perceived behavioral control ($P < 0.001$), family support and reinforcement ($P < 0.001$), and oral health-related behavior ($P < 0.001$) [Tables 2-4]. The greatest impact of the current educational program was on knowledge, social support, and perceived benefits [Figure 1]. Finally, 2 months after educational program was implemented, 30.4% of the changes in children’s oral health-related behavior resulted from this program.

Discussion

Undoubtedly, children’s oral health is an issue of paramount importance and it affects the QoL of both children and families.^[20,21] Since it is necessary to pay attention to children’s health, oral health intervention programs must be designed, implemented, and evaluated to meet international indices and standards. Considering the nature of PRECEDE–PROCEED model, a participatory and community-based model that provides planners with the process of designing, implementing, and evaluating interventions,^[16] the present study aimed to design, implement, and evaluate an educational intervention to empower mothers as the most important figures in the health promotion of 3–6-year-old children. The present research was done to study demographic characteristics, knowledge, attitude, perceived threat,

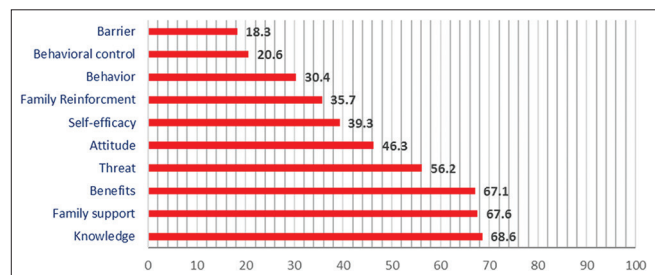


Figure 1: Percentage of changes resulting from the educational program on predisposing, enabling, and reinforcing factors and oral health behavior of 3–6 year-old children

perceived benefits, and self-efficacy as predisposing factors in adopting toothbrushing behaviors.

Since mothers’ oral health-related knowledge has a significant association with oral health of children.^[33] In Gurunathan *et al.*’s study, mothers’ knowledge about brushing behavior, treatment, and the importance of regular visits and checking of preschool children’s teeth was not desirable.^[34]

In the present study, mothers’ knowledge about oral health of 3–6-year-old children was not significant before the intervention between two groups. To improve mothers’ knowledge, 45-min face-to-face educational session and virtual session were held to explain the importance of children’s oral health, the signs and symptoms of caries, the characteristics of a proper toothbrush, and the proper way to brush and floss the teeth. In these classes, different teaching methods and procedures were applied, such as lectures, group discussions, questions and answers, and explaining experiences, and educational materials, such as PowerPoint, booklets, and educational pamphlets were used. About 68.6% of the changes in mothers’ knowledge after the intervention resulted from the intervention. Mehdipour *et al.*^[35] and Alzaidi *et al.*^[36] also revealed similar results. In the study of Halawany *et al.*, an 11% increase was observed in the level of awareness of primary Saudi girls aged 6–8 years after the intervention,^[37] which was about 21% in the

Table 2: Comparison of the mean score of predisposing factors before and 2 months after the intervention in two groups

Structure	Group	Mean±SD		P*
		Before of intervention	After of intervention	
Knowledge (0-46)	Intervention	33.88±4.24	43.77±1.71	<0.001
	Control	32.58±5.15	34.50±5.41	<0.003
	P**	0.172	<0.001	
Co-variate (R^2 , P , ηp^2)		0.686, <0.001, 0.61		
Attitude (6-30)	Intervention	22.12±2.64	24.08±2.85	<0.001
	Control	22.72±3.30	21.04±1.96	<0.001
	P**	0.319	<0.001	
Co-variate (R^2 , P , ηp^2)		0.463, <0.001, 0.44		
Perceived threat (8-40)	Intervention	30.98±2.11	36.83±2.54	<0.001
	Control	32.22±2.54	31.08±3.31	0.386
	P**	0.061	<0.001	
Co-variate (R^2 , P , ηp^2)		0.562, <0.001, 0.53		
Perceived benefit (10-50)	Intervention	39.58±2.99	47.63±2.23	<0.001
	Control	42.02±5.20	40.52±4.14	<0.001
	P**	0.001	<0.001	
Co-variate (R^2 , P , ηp^2)		0.671, <0.001, 0.67		
Self-efficacy (7-35)	Intervention	24.78±2.57	29.08±3.72	<0.001
	Control	26.80±4.74	24.30±4.51	<0.001
	P**	0.010	<0.001	
Co-variate (R^2 , P , ηp^2)		0.393, <0.001, 0.36		

*Independent t-test, **Paired t-test. SD=Standard deviation

Table 3: Comparison of the mean score of enabling factors before and 2 months after the intervention in two groups

Structure	Group	Mean±SD		P*
		Before of intervention	After of intervention	
Perceived barrier (6-30)	Intervention	22.10±1.77	18.65±5.10	<0.001
	Control	22.20±3.72	22.06±2.78	0.752
	P**	0.864	<0.001	
Co-variate (R^2 , P , ηp^2)		0.183, <0.001, 0.15		
Perceived behavioral control (4-20)	Intervention	12.04±1.88	13.91±1.64	<0.001
	Control	12.54±2.42	12.70±2.68	0.639
	P**	0.253	0.008	
Co-variate (R^2 , P , ηp^2)		0.206, 0.001, 0.11		

*Independent t-test, **Paired t-test. SD=Standard deviation

present study, which is due to the target group of the intervention.

Since promoting knowledge underlies attitude formation, it is suggested that researchers design and implement the necessary interventions to improve the knowledge of mothers of 3–6-year-old children via different channels such as mass media or through more serious education in kindergartens, health centers, and clinics.

Attitude, a predisposing factor, refers to a person’s point of view, that is, how much a person feels a certain behavior is pleasant, favorable, and desirable, and it depends on the person’s judgment about the outcome of that behavior.^[16] Mothers’ attitudes toward oral health have a direct impact on the outcomes of children’s oral health.^[38] In the present research, mothers did not have

a favorable attitude toward the effects of brushing (such as the effects of toothpaste, brushing after consuming sugars, and the proper brushing technique) on their children’s oral health. However, after the intervention, a significant increase was observed in this construct, which is consistent with the research done by Chand *et al.*^[33] The covariance test confirmed that 46.3% of the changes in mothers’ attitudes resulted from the educational program. In Rabiei *et al.*’s study, 59% of mothers had a positive attitude toward their 2–5 year old children going to the dentist for periodic examinations.^[32] In the meta-analyses of Smith *et al.*, parental’ attitudes were one of the influential factors on oral health of preschool children ($r^+ = 0.18$).^[39]

In this study, after teaching the mothers about the positive impacts of giving serious consideration to oral

Table 4: Comparison of the mean score of reinforcing factors and behavior before and 2 months after the intervention in two groups

Structure	Group	Mean±SD		P*
		Before of intervention	After of intervention	
Family support (8-40)	Intervention	29.26±3.21	36.69±2.16	<0.001
	Control	31.58±4.64	31.10±3.01	<0.001
	P**	0.011	<0.001	
Co-variate (R ² , P, ηp ²)		0.676, <0.001, 0.66		
Family reinforcement (4-20)	Intervention	13.74±1.77	17.08±2.15	<0.001
	Control	15.84±2.93	14.92±2.11	0.115
	P**	<0.001	<0.001	
Co-variate (R ² , P, ηp ²)		0.357, <0.001, 0.33		
Behavior (6-24)	Intervention	13.32±2.69	16.46±2.79	<0.001
	Control	13.66±2.22	13.26±2.82	0.401
	P**	0.493	<0.001	
Co-variate (R ² , P, ηp ²)		0.304, <0.001, 0.27		

*Independent t-test, **Paired t-test. SD=Standard deviation

health-related behaviors and explaining its negative consequences for different aspects of the QoL, the mean scores of perceived threat and perceived benefits of mothers increased compared to the time prior to the intervention, which was in line with the findings of Peyman and Pourhaji.^[40] In their study, Gomes *et al.* parents' perception of general health as a poor condition, negative impact on family QoL, history of toothache, and tooth decay considered as variables affecting the oral health of Brazilian preschool children.^[41]

Self-efficacy, another predisposing factor, means that an individual feels confident of accomplishing a job.^[16] In this study, the concept of self-efficacy is the mother's confidence to help her child brush teeth after each meal and after eating sweets, and avoid breaking hard nuts with his/her teeth. The mean self-efficacy score after the intervention reached 29.08%, showing a significant increase compared to the time before the intervention. In the study of Ghorbani *et al.*,^[42] a similar significant increase was observed after the intervention. Moreover, increasing self-efficacy in oral health-related behavior makes parents eager to arrange for their children to benefit from preventive dentistry and regular visits to the dentist.^[43] The researchers recommend using Bandura's four strategies such as breaking down complex behaviors and dividing them into smaller, simple, and feasible stages, using demonstration methods, implementing peer education programs, reducing stress, and encouragement. It also suggests self-regulatory model-based behavioral interventions to correct misconceptions about caries and promote oral health in children.^[44]

The enabling factors of paramount importance related to toothbrushing behavior include perceived barriers, self-efficacy, and perceived behavioral control. The most important perceived barriers in this study were boredom, intolerance of toothpaste, nausea and vomiting during toothbrushing, and bleeding gums. However, using

teaching methods involving questions and answers, group discussions about choosing the right toothbrush, the proper brushing technique, and explaining the importance of oral health and its impact on general health, the mean score of perceived barriers decreased significantly. In the study of Shirzad *et al.*,^[18] a similar statistically significant difference was observed.

Another construct was perceived behavioral control, which means how much an individual feels that he can take the right action in accordance with an enacted behavior. In this study, perceived behavioral control was mothers' ability to brush their children's teeth while traveling, or in cases of illness, lack of toothpaste, or boredom. Soltani *et al.* reported that perceived behavioral control, subjective norms, and attitudes were the strongest predictors of intention to oral health behaviors in preschool children in Tabriz (North-West Iran).^[45]

With regard to the effect of educational intervention on perceived behavioral control, there was a significant increase in the intervention group after the educational intervention. Makvandi *et al.* revealed that oral health education to mothers of children aged 1–2 years old significantly increases their perceived behavioral control score.^[46] The findings of Peyman and Pourhaji were also consistent with the present study.^[40] The findings of the study by Peyman and Pourhaji are further evidence on the effectiveness of an educational program based on the health belief model on oral health behaviors of primary school children.^[40]

Other important reinforcing factors were family support and social strengthening, undoubtedly, the performance and support of the family in the oral health of children has been confirmed in other studies.^[47,48]

In educational classes held for the mothers, the researchers asked for their support and cooperation to implement the

intervention program, for example in setting a bedtime routine for the child, guiding, supervising and helping the child while brushing teeth, as well as more serious training, asking health centers and kindergartens to encourage children to brush their teeth, and asking for support of mass media such as radio and television. In this study, the outcome assessment was not done due to time constraints. Therefore, it is recommended that other researchers perform this assessment in their research.

The oral health-related behavior of mothers of 3–6-year-old children was equal to 13.32% out of 24 scores before the intervention, which increased significantly in the constructs of knowledge, attitude, perceived threat and benefits, self-efficacy, perceived behavioral control, social support, and reduction of perceived barriers, and the score reached 16.46 after the intervention. This increase indicates that the educational program was effective and the model was efficient in health education and health promotion. Fard *et al.*^[15] also performed a quasi-experimental pre-post-intervention aimed to investigate the effects of teaching how to prevent premature tooth decay on knowledge, attitude, and performance of pregnant mothers visiting health centers in Yazd. The findings point to the positive effect of the educational program on increased knowledge, attitude, and short-term performance of pregnant mothers in preventing premature tooth decay in children.

Limitation and recommendation

The use of PRECEDE–PROCEED model as a community-based model for design, implementation, and evaluation of intervention and identification of predisposing, enabling, and reinforcement factors of children's oral health is one of the strengths of the present study. Most of the studies have been done on primary schoolchildren, so paying attention to this target group is also one of the strengths of the research. The poor participation of mothers in the implementation of the program due to the outbreak of COVID-19 was one of the limitations of the intervention that delayed the work process.

According to the findings of the present study, for oral health programs to succeed, constant education of mothers about the importance of their children's teeth should begin before the deciduous teeth erupt, based on the individual needs of children and parents.

Conclusion

Based on a review of prior research, group discussion with mothers and oral health specialists, the most important predisposing factors include constructs of knowledge, attitude, self-efficacy, perceived threat, and benefits, enabling factors include constructs of

perceived barriers and perceived behavioral control, and reinforcing factors include family support and strengthening. The present intervention program based on the PRECEDE–PROCEED model was effective in improving the score of predisposing, enabling, and reinforcing factors and tooth brushing behavior. The greatest impact of the educational program was on knowledge, social support, and perceived benefits. At the end, 30.4% of the changes in oral health behavior resulted from the designed educational program. Considering the importance of planning to promote children's oral health, the researchers recommend using PRECEDE–PROCEED model in designing, implementing, and evaluating evidence-based interventions.

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Conflicts of interest

There are no conflicts of interest.

References

1. AbdAllah EA, Metwalli NE, Badran AS. Effectiveness of a one year oral health educational and preventive program in improving oral health knowledge and oral hygiene practices of a group of Autistic Egyptian children and their caregivers. *Future Dent J* 2018;4:9-23.
2. Goodarzi A, Tavaffian S, Heidarnia A, Ziaoddini H. Health literacy and oral health in primary school students of district 14 in Tehran, Iran. *J Mil Caring Sci* 2016;2:229-37.
3. Smailikia M, Gholami-Parizad E, Abedzadeh-Zavareh MS, Sayehmiri K, Ghazanfari Z. Predicting the status of children's dental oral health 3-6 old city Ilam the health belief model. *SJIMU* 2015; 24 (3): 49-58.
4. Sujlana A, Pannu PK. Family related factors associated with caries prevalence in the primary dentition of five-year-old children. *J Indian Soc Pedod Prev Dent* 2015;33:83-7.
5. Mohammadi M, Raygani AA, Jalali R, Ghobadi A, Salari N. Prevalence of decay of permanent and deciduous teeth in Iranian children: A systematic review and meta-analysis study. *J Dent Sci* 2018;15:180-9.
6. Spanemberg JC, Cardoso JA, Slob EM, López-López J. Quality of life related to oral health and its impact in adults. *J Stomatol Oral Maxillofac Surg* 2019;120:234-9.
7. Pakpour A, Hidarnia A, Hajizadeh E. Oral health status and related factors in sample of high school students. *J Qaz*

- Univ Med Sci 2011;15:55-60.
8. Nejad EM, Shariat E, Begjani J, Abotalebi G. Evaluation of oral health in primary school children in Saveh, Iran (text in Persian). *J Res Dev Nurs Midwifery* 2011;8:74-80.
 9. Ruff RR, Senthil S, Susser SR, Tsutsui A. Oral health, academic performance, and school absenteeism in children and adolescents: A systematic review and meta-analysis. *J Am Dent Assoc* 2019;150:111-21.e4.
 10. Dallal MM, Dargahi H, Mehrani F, Yazdi MK, Forushani A, Miremadi SA. The role of streptococcus mutants in dental caries in two groups of sensitive and resistance children age between 3 to 5 years. *Payavard Salamat J* 2013;6:467-77.
 11. Wulaerhan J, Abudureyimu A, Bao XL, Zhao J. Risk determinants associated with early childhood caries in Uygur children: A preschool-based cross-sectional study. *BMC Oral Health* 2014;14:136.
 12. Goudarzi A, Heidarnia A, Tavafian SS, Eslamiyan M. Relationship of social variables with oral health of students. *Iran J Pediatr* 2018;14:1-10.
 13. Janakiram C, Rudrappa R, Taha F, Ramanarayanan V, Akalgud H, Kadanakuppe S. Equity in oral healthcare in India: A review on health system analysis. *Econ Polit Wkly* 2017;52:82-9.
 14. Naderifar M, Ghaljaei F, Akbarizadeh M. Determination of the mothers; practice about odontal health of their children up to six years old. *Zahedan. J Res Med Sci* 2010;12:43-8.
 15. Fard RG, al-Ulumi ZB, Hosseini A, Samani ZJ, Mirzaeian A. The effect of teaching methods to prevent premature tooth decay in children awareness, attitude and practice of pregnant mothers. *Med Care* 2020;22:25-33.
 16. Glanz K, Rimer B, Viswanath K. *Health Behavior and Health Education. Theory, Reserch, and Practice*. 5th ed. USA; Wiley. 2015.
 17. Hajimiri K, Sharifirad G, Hasanazade A. The effect of oral health education based on health belief model in mothers who had 3-6 year old children on decreasing dental plaque index in Zanjan. *J Adv Med Biomed Res* 2010;18:77-86.
 18. Shirzad M, Taghdisi M, Dehdari T, Abolghasemi J. The impact of educational intervention on mothers' attitude, self-efficacy and perceived barriers to health oral preschool children. *Iran J Health Educ Heal Promot* 2015;3:181-7.
 19. Ghaffari M, Rakhshanderou S, Asadpour M, Nasirzadeh M, Mazar L. Design, implementation, and evaluation of a PRECEDE-PROCEED model-based intervention for oral and dental health among primary school students of Rafsanjan city: A mixed method study. *BMC public health*. 2021; 21 (1):1-0.
 20. Ghaffari M, Rakhshanderou S, Asadpour M, Nasirzadeh M. Oral health behavior and its relationship with quality of life among 12 year-old children of Rafsanjan in 2017-18. *J Kerman Univ Med Sci* 2019;26:420-9.
 21. Ghaffari M, Rakhshanderou S, Mazar L, Nasirzadeh M. Effect of children's oral health on families' quality of life: A cross-sectional study in Rafsanjan, Iran. *Community Dent Oral Epidemiol* 2020;9:65-72.
 22. Gisoure E, Salary Z, Shahrokhi E. Relationship between socioeconomic status and quality of life affected by oral health in preschool children in Kerman, Iran, During 2016-2017. *Natl Acad Manag Staff Cult Arts Herald* 2018; 3; 1084-91.
 23. Gomes MC, Perazzo MF, Neves ET, Martins CC, Paiva SM, Granville-Garcia AF. Oral Problems and Self-Confidence in Preschool Children. *Braz Dent J* 2017;28:523-30.
 24. Jahanshahi R, Mirzayi F, Sanagou A, Jouybari L. Survey of oral health index in elementary school students in Nasrabad village (Gorgan) based on Child-OIDP index in 1397. *Iran J Pediatr* 2018;14:25-36.
 25. Krisdapong S, Prasertsom P, Rattanarangsima K, Sheiham A. School absence due to toothache associated with sociodemographic factors, dental caries status, and oral health-related quality of life in 12- and 15-year-old Thai children. *J Public Health Dent* 2013;73:321-8.
 26. Reza M, Amin MS, Sgro A, Abdelaziz A, Ito D, Main P, *et al.* Oral health status of immigrant and refugee children in north America: A scoping review. *J Can Dent Assoc* 2016;82:g3.
 27. Mohammadi TM, Haji-Zamani A. *Indicators of Health and Disease in Dentistry*. 1st ed. Tehran: Darkob Publications; 2011.
 28. al-Aalim ZB, Suleimani A, Zandi H, Dastjerdi F, Rashidi M, Nejad SA. Investigation of the effect of environmental factors and presence of caries early childhood on streptococcus counts Mutans Saliva in Yasd City for 3-5 year old children. *Toloo-e-behdasht J* 2017;15:23-4.
 29. Hoover J, Vatanparast H, Uswak G. Risk determinants of dental caries and oral hygiene status in 3-15 year-old recent immigrant and refugee children in Saskatchewan, Canada: A pilot study. *J Immigr Minor Health* 2017;19:1315-21.
 30. Kalantari B, Rahman J, Hatami H, Factory S, Farsar A, Sharifpour A, *et al.* Prevalence of tooth decay and its related factors in 6 and 7 year old children in Shemiranat health network. *J Health Field* 2013;1:7-13.
 31. Takelou ZN, Tabatabai SA, Zul-Ali F, Mohabbat M. Factors influencing oral health promotion behaviors based on Boznoff's model elementary school boy students. *J Health Res* 2016; 2 (3):259-73.
 32. Rabiei L, Masoudi R, Shirani M. Evaluation of knowledge, attitude and practice of mothers referring to health centers in Isfahan to the oral health care of 2-5 year old children. *J Vulnerable Groups Nurs* 2015;2:55-64.
 33. Chand S, Chand S, Dhanker K, Chaudhary A. Impact of mothers' oral hygiene knowledge and practice on oral hygiene status of their 12-year-old children: A cross-sectional study. *J Indian Assoc Public Health Dent* 2014;12:323-9.
 34. Gurunathan D, Moses J, Arunachalam SK. Knowledge, attitude, and practice of mothers regarding oral hygiene of primary school children in Chennai, Tamil Nadu, India. *Int J Clin Pediatr Dent* 2018;11.4:338.
 35. Mehdipour A, Montazeri-Hedeshi Ro, Asayesh H, Karimi A, Omidi Kopayee R, Asgari H. Evaluation of knowledge, attitudes and performance of the parents of preschool and primary school children referred to health centers of Qom city about the importance of preserving primary teeth and its related factors, Iran. *Qom Univ Med Sci J* 2016;10:94-105.
 36. Alzaidi SS, Alanazi IA, Nawas OM, Mulla MA. Childhood oral health: Maternal knowledge and practice in Tabuk, Saudi Arabia. *Egypt J Hosp Med* 2018;70: 1544-51.
 37. Halawany HS, Al Badr A, Al Sadhan S, Al Balkhi M, Al-Maflehi N, Abraham NB, *et al.* Effectiveness of oral health education intervention among female primary school children in Riyadh, Saudi Arabia. *Saudi Dent J* 2018;30:190-6.
 38. Batra M, Shah AF, Virtanen JI. Integration of oral health in primary health care through motivational interviewing for mothers of young children: A pilot study. *J Indian Soc Pedod Prev Dent* 2018;36:86-92.
 39. Smith SR, Kroon J, Schwarzer R, Hamilton K. Parental social-cognitive correlates of preschoolers' oral hygiene behavior: A systematic review and meta-analysis. *Soc Sci Med* 2020;264:113322.
 40. Peyman N, Pourhaji F. The effects of educational program based on the Health Belief Model on the oral health behaviors of elementary school students. *Mod Car J* 2015;12:74-8.
 41. Gomes MC, Clementino MA, Pinto-Sarmento TC, Costa EM, Martins CC, Granville-Garcia AF, *et al.* Parental perceptions of oral health status in preschool children and associated factors. *Braz Dent J* 2015;26:428-34.
 42. Ghorbani B, Shahnazi H, Hassanzadeh A. Improving student's self-efficacy and perceived susceptibility toward oral and dental health: A randomized controlled trial. *Oman Med J* 2018;33:423-8.
 43. Askelson NM, Chi DL, Momany ET, Kuthy RA, Carter KD,

- Field K, *et al.* The importance of efficacy: Using the extended parallel process model to examine factors related to preschool-age children enrolled in Medicaid receiving preventive dental visits. *Health Educ Behav* 2015;42:805-13.
44. Nelson S, Slusar MB, Albert JM, Riedy CA. Do baby teeth really matter? Changing parental perception and increasing dental care utilization for young children. *Contemp Clin Trials* 2017;59:13-21.
45. Soltani R, Sharifirad G, Mahaki B, Eslami AA. Determinants of oral health behavior among preschool children: Application of the theory of planned behavior. *J Dent (Shiraz)* 2018;19:273-9.
46. Makvandi Z, Karimi-Shahanjarini A, Faradmali J, Bashirian S. Evaluation of an oral health intervention among mothers of young children: A clustered randomized trial. *J Res Health Sci* 2015;15:88-93.
47. Duijster D, Verrips GH, van Loveren C. The role of family functioning in childhood dental caries. *Community Dent Oral Epidemiol* 2014;42:193-205.
48. Duijster D, de Jong-Lenters M, Verrips E, van Loveren C. Establishing oral health promoting behaviours in children – Parents’ views on barriers, facilitators and professional support: A qualitative study. *BMC Oral Health* 2015;15:157.