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Parents' Perception of Fissure Sealant Therapy in 6-12 Year Old Children: Evaluating a theory-driven intervention

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Background: Dental caries is considered a major global health issue and among the most challenging diseases worldwide. An effective way of preventing dental caries is the fissure sealant (FS) therapy. ***Objective***: To determine the effectiveness of an educational intervention developed based on the health belief model (HBM) for parents' perception of FS therapy for their children. ***Methods***: Quasi-experiment among 300 parents of 6-12 year-old children, 150 in the intervention group (IG) and 150 in the control (CG), in the south of Iran recruited via both clustering and convenience sampling. Data were collected using a validated questionnaire collecting demographic information, knowledge and data on HBM constructs and FS behaviour. Eight intervention sessions, 40-60 minutes long, were held for over month. The primary outcome was child's receipt of fissure sealants 3 months after the intervention. ***Results***: The two groups had similar knowledge and the HBM constructs at baseline. After the intervention, the receipt of FS therapy was 65% and 12% in the IG and CG, respectively ($p < 0.001$, Chi Sq.). ANCOVA supported post-test differences between the intervention and control groups when accounting for baseline scores ($p<0.05$). ***Conclusions***: The educational HBM-based intervention improved parents' perceptions and their children's receipt of FS therapy. The intervention affected the HBM constructs. Barriers to healthy oral/dental behaviours may be reduced by interventions at multiple layers (beyond the individual level).

Keywords*: Dental caries, Health Belief Model, Fissure Sealant Therapy*

Introduction

The rate of child dental caries is increasing in many countries and is a major global health problem. Dental caries afflicts many children worldwide (Albino and Tiwari, 2016; Anil and Anand, 2017). In a systematic review, the prevalence of caries in permanent teeth in children within a sample of 1,454,871 participants at a global scale was reported to be 53.8% (CI: 50-57.5% 95%) (Karimy *et al.*, 2020). In Iran, the same review reported the prevalence of caries in children's deciduous and permanent teeth to be 62.8% and 78.6%, respectively. Other studies have found the prevalence of caries in primary and permanent teeth among Iranian children is much higher than the standards set by the World Health Organization (Karimy *et al.*, 2020).

Oral health affects child health both physically and psychologically. Children with dental caries face many problems while sleeping, playing, eating, and studying. Children's physical and social health and self-esteem are adversely affected by the loss of teeth, or any change of colour or physical damage to the teeth (Turton and Durward, 2017). Considering the high prevalence of dental caries and its adverse effects, more preventive oral/dental measures are required to protect the teeth (Zakirulla *et al.*, 2019). One way to prevent dental caries is fissure sealant (FS) therapy (Wells, 2019). There is evidence for the effectiveness and cost-effectiveness of FS therapy in preventing dental caries (Al-Sultani *et al.*, 2020; Nair and Singh, 2016; Weintraub *et al.*, 2001).

A first step to prevent dental caries is awareness-raising. Thus, health education is a key element towards the prevention of oral diseases and promotion of social health (Karimy *et al.*, 2020). Theory-based educational interventions are more likely to be effective and educational programs based on behaviour change theories are the most effective (Abbaspour *et al.,* 2021). One such framework, prominent in health education is the Health Belief Model (HBM, Figure 1), which has been shown to be effective in promoting oral/dental health (Karimy *et al.*, 2020). According to this model, parents should first perceive their children at risk of dental caries (termed as perceived susceptibility). Then, they should perceive the adverse effects of dental caries on different aspects of the child's life (e.g. physical, mental, social and economic) (perceived severity). They should also use the cues from their surroundings or their inner world (cues for action) to recognise the usefulness and practicality of FS therapy (perceived benefits). They should perceive the physical, financial and mental barriers to such healthy behaviors (perceived barriers) as less costly than the benefits. In addition, they should perceive themselves as capable of showing the target behaviour (i.e., self-efficacy) so that they can finally undertake that behaviour (here the FS therapy) (Feyisa and Temesgen, 2019).

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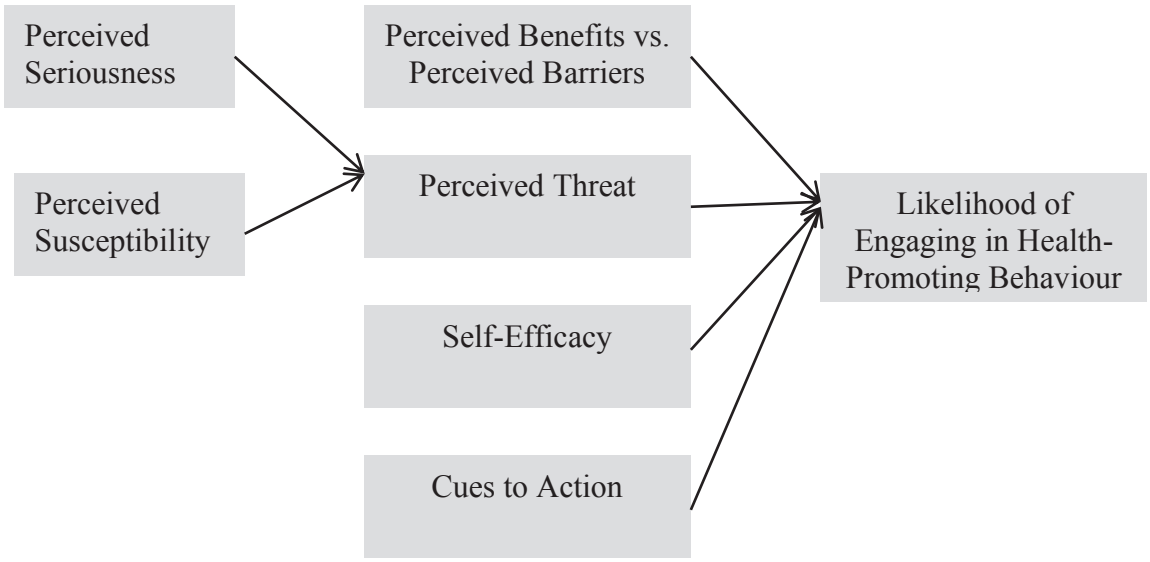

Figure 1. *Schematic of the Health Belief Model.*

To our knowledge, there is only one study using health education theory in relation to receipt of fissure sealants. Einollahzadeh et al. (2021) used the theory of planned behaviour to explore parents' reception of FS therapy for their children. The adopted theory, dominant culture, type of intervention and research setting differed from our own area and could only be applied with caution. Thus, due to the major role parents play in preventing dental caries in children (Adair *et al.*, 2013), we were motivated to investigate this role for the first time in the south of Iran. Thus, we aimed to determine the effectiveness of an educational intervention developed based on the HBM among parents toward their children's receipt of FS. The research hypotheses were as follows:

1. After the intervention, all HBM constructs would differ between the two research groups.
2. After the intervention, more children would receive FS in the intervention than the control group.

Method

This quasi-experimental study was conducted with an intervention and control group (IG and CG), in the south of Iran in 2019 and 2020 to assess the effectiveness of an educational intervention developed based on the HBM in parents' reception of FS therapy for their 6-12-year-old children with three-month follow-up.

The inclusion criteria were having a 6-12-year-old child, no history of FS therapy (for the child), no history of dental intervention (preventive or medical), being literate and willing to participate in the research. The exclusion criteria were failure to attend classes regularly (absence for more than 2 sessions), being available for the post-test, failure to return a complete questionnaire, and the child requiring emergent dental care.

The power calculation was based on the following assumptions (Shirzad *et al.*, 2015). The variances in the IG and CG were 10.77 and 9.10, respectively. The minimally important difference between the mean scores of the two groups was 3. Type I error was 5% and the test power was 90%. With a correction coefficient of 2, the sample size was estimated at 150 for each group.

Sampling took place in two stages. First, the six healthcare centres in Hajiabad County that had dental officers were divided to the IG and CG groups. Three centres that were close to each other were selected as the IG with the remainder as the CG, to prevent contamination of knowledge between the groups. Second, in each healthcare centre, convenience sampling selected fifty parents of 6–12-year-old children. Parents regularly visited the centre for routine health care, met the inclusion criteria and were selected voluntarily.

The pre-test was given to participants in the two groups using a questionnaire exploring HBM constructs. The pre-test results facilitated a needs analysis to decide on the teaching material and method and the length of the educational program. The content was tailored to participants' comprehension levels. Scientific sources were used, guided by expert comments. The first participants also commented on the content. The content was developed based on the subscales of the HBM, and was finally approved by experts in health education. At the end of each session, a survey monitored the content and educational approach used (Details available on request). A total number of 8 sessions were held over two months in 10-15 groups. Each session lasted 40 to 60 minutes with a 10-minute break. The intervention involved lectures, cooperative discussions, brainstorming, concept mapping, use of movies or photos, act-outs, animated movies, slide presentations, posters and pamphlets. The content of the educational intervention included: 1. The state of oral/dental health in the county, 2. General considerations about oral/dental health, 3. Dental structure, functioning and diseases, 4. Dental caries, its prevention and the relevant indices, 5. Filled or lost teeth, 6. Effect of dental caries on children's educational and social affairs, 7. Future costs of dental caries, 8. Introducing FS therapy as a preventive measure for dental caries; showing FS therapy to dentists, 9. Benefits of preventing dental caries. The educational intervention was led by a researcher

in health promotion who was experienced in educational interventions and health promotion, a dentist with more than 10 years of experience and parents whose children had received FS therapy. All participants cooperated until the end of the study, with no sample attrition. The CG received a single 60-minute session on general matters related to oral/dental health during.

Three months after the intervention, the post-test self-report questionnaire was administered to both groups. Where participants had difficulty with the questionnaire, the questions were read out aloud and the responses recorded with no interpretation or change by the interviewer. The questionnaire completion took 25 to 30 minutes.

The questionnaire contained closed items in three parts. The first part contained 8 items enquiring about participants' demographic information: parents' age (in years), categorised as 20-30 or 30-60-years, educational attainment (below diploma, diploma or university degree), paternal occupation (official job, other), maternal occupation (homekeeper, other), place of residence (urban, rural), income (fair, low) and the child's grade at school (1st, 2nd, 3rd, 4th, 5th and 6th grade). The second part contained 7 questions to assess participants' awareness of oral/dental health, each with possible *yes/no/don't know* answers. A *yes* answer was scored as 1 and a *No* or *don't know* as 0, creating a possible range of 0 to 7, with higher scores indicating greater awareness.

The final part of the questionnaire assessed the six HBM sub-scales. Perceived threat included perceived susceptibility and severity. Perceived susceptibility was rated with 4 items such as "Though my child brushes his/her teeth regularly, s/he is prone to dental caries and had better have the FS therapy". Perceived severity was rated with 6 items including "Not having FS therapy can lead to dental caries or abdominal diseases for my child". Perceived benefits were rated with 5 items such as "FS therapy can help prevent my child's dental caries". Perceived barriers were rated with 8 items including "The absence of an experienced dentist has stopped me going for FS therapy for my child". Self-efficacy was rated using 5 items including "Although I am too busy, I can find the time for my child's FS therapy". The relevant items were all rated on a 5-point Likert scale: 1. Strongly agree, 2. Agree, 3. Neutral, 4. Disagree, 5. Strongly disagree, with scores summed for each sub-scale and each participant. A higher score showed stronger feelings on the sub-scale. All sub-scales had positive responses toward the target behaviour (child's receipt of FS therapy), except for perceived barriers which was correlated negatively (Figure 2).

The data collection instrument was derived from the related literature, in the light of guidelines published by the American Dental Association (ADA), the European Academy of Pediatric Dentistry (APD), and American APD in the area of fluoride and FS therapy. Before data collection, the instrument was piloted with 20 people similar to the participants. Their feedback was used to revise the content and better organize the items. The questionnaire was also reviewed by a panel of experts to assess its readability, simplicity and relevance. Their comments were used further to revise the survey. The questionnaire was submitted twice at a 2-week interval to 20 adults who were similar to the participants. The ICC was 0.86, substantiating its test-retest reliability.

The primary outcome was the child's receipt of FS therapy. This therapy was offered free of charge by a dentist assistant to both groups. The number of FS therapies provided was confirmed by the dentist assistant. Secondary outcomes included greater perception of susceptibility to and severity of cares, self-efficacy and benefits of FS, and fewer perceived barriers to FS.

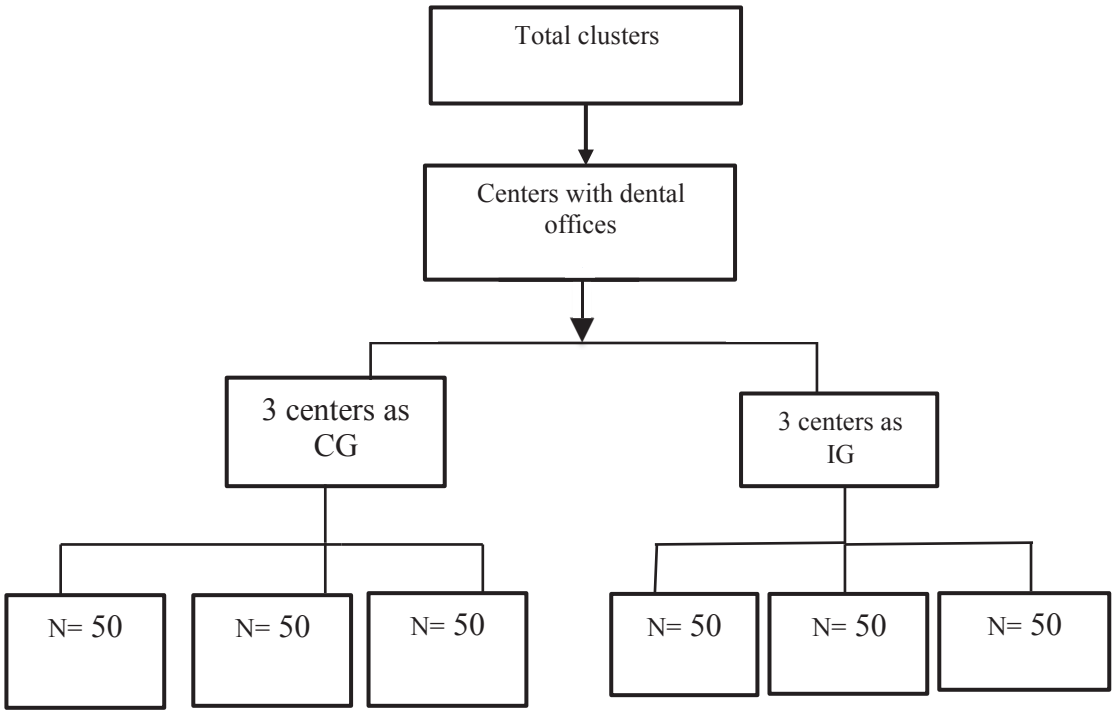

Figure 2. *Flowchart of sample selection.*

Data description used means and standard deviation and frequencies of categoric data. The assumptions of parametric tests and normality of data were determined with Kolmogorov-Smirnov test and Levene's tests. Independent-sample *t*-tests were used for between-group comparisons of the HBM sub-scales and paired-samples t-test for within-group comparisons. ANCOVA was used to compare post test scores whilst adjusting for baseline scores. The effect of each sub-scale on the behaviour score in the intervention group was determined using multiple regression, with the behaviour considered as the dependent variable and the HBM sub-scales as independent. All analyses were conducted in SPSS20.

We followed the principles of the declaration of Helsinki and the Nuremberg Code. The protocol was approved by the Ethics Committee of Hormozgan University of Medical Sciences (#IR. HUMS.REC1397.222). Oral and written informed consent was obtained from each participant. After the study the educational intervention was provided to the control group.

Results

Our quasi-experimental study was conducted with 300 parents of 6-12-year-old children (150 in each group). Most parents were aged 30-40 years and were mothers (74% of the IG and 54.7% of the CG). In both groups, most parents had not attained a diploma level of education. Most were rural residents (53.3%) (Table 1).

Before the intervention, the mean awareness and HBM scores were similar in the two groups. However, after the intervention, the awareness score and HBM sub-scale scores differed across groups ($p<0.001$, Table 2). After the intervention 65% of the children of parents in the intervention group had received fissure sealants compared to 12% of those in the control group ($p < 0.001$, Chi sq)

Analysis of covariance (ANCOVA) was used to control the effect of baseline scores. First, the assumptions for this analysis were confirmed, including linearity and the homogeneity of variance and regression slopes. ANCOVA revealed that the pre-test scores (as the covariate) predicted the awareness score and the HBM sub-scales (Table 3). The same table indicated that receiving the educational intervention also predicted the awareness score and the HBM sub-scales.

Logistic multiple regression tested the effect of each HBM sub-scale on the target behaviour. All HBM sub-scales predicted receipt of FS. Perceived susceptibility was the strongest predictor (OR=2.35, Table 4).

Table 1. Characteristics of intervention and control groups.

Variables	*Category*	*Intervention n=150 (%)*	*Control n=150 (%)*
Research participant	father	26.0	45.3
	mother	74.0	54.7
Parent's age	20-35	50.0	52.0
	36-60	50.0	48.0
Parent's education level	Below diploma	58.7	52.7
	Diploma	28.0	39.3
	University Degree	13.3	8.0
Place of residence	Urban	46.7	46.7
	Rural	53.3	53.3
Father's occupation	White-collar	27.3	11.3
	Other	72.7	88.7
Mother's occupation	Housewife	89.3	95.3
	Other	10.7	4.7
Income	Less than fair	67.3	70.0
	Fair	32.7	30.0
Child's school grade	1st and 2nd	30.7	34.0
	3rd and 4th	35.3	35.3
	5th and 6th	34.0	30.7

Discussion

Parents play a pivotal role in preventing dental caries in their children. Thus, we examined the effect of an educational intervention based on the HBM among parents on their childrens' receipt of FS therapy. The HBM provided a useful framework to promote healthy oral/dental behaviors. As suggested by Nutbeam (1998), oral health promotion interventions are evaluated at four levels: health promotion measures (education), health promotion outcome (higher awareness and knowledge of oral/dental health), intermediate health outcomes (reception of FS therapy), and finally examining the health indicators (the level of dental caries and plaque). This research attempted to consider all levels. The final level is not reported here due to time limitations, but will be reported later.

Parents' awareness of FS therapy was very low before the intervention thus previous awareness-raising of this issue had been limited or had proved ineffective. This is consistent with previous research indicating that Iranian parents' awareness of the dental caries prevention is low (Aravindan *et al.*, 2019; Tahani, 2017). In contrast, in other studies parents showed sufficient awareness of the FS therapy (Jafari *et al.*, 2011; Lakshmanan and Gurunathan, 2020). These contradictory findings can be explained by the differing socio-demographic features of the research populations and divergent purposes of study, survey contents and cultures.

Awareness of fissure sealants increased in the intervention group after the intervention. This finding is also consistent with other studies that showed greater awareness of caries prevention through educational interventions (Farzaneh *et al.*, 2021; Ghafourifard *et al.*, 2020; Halawany *et al.*, 2018). This finding points to the educational intervention based on the HBM increased knowledge of the FS behaviour in oral/dental health. It is also possible that the awareness and knowledge affected the other HBM sub-scales and, thus, improved parents' willingness for their children to receive FS therapy.

The two groups had similar perceptions of threat before the intervention but differed significantly in this regard afterwards. Other interventions have been shown to increase the perceived threat of oral dental caries (Basir *et al.*, 2017; Ghazanfari *et al.*, 2021; Nickbin Poshtamsary *et al.*, 2020). By contrast, one study failed to find an

Table 2. Health Belief Model sub-scale scores in the intervention and control groups at baseline and 3-month follow-up.

	Group	*Baseline (Mean±SD)*	*Follow-up (Mean±SD)*	*p**
Awareness	Intervention	3.37±1.81	6.64±.66	>0.001
	Control	3.31±1.77	3.59±1.56	0.147
	p **	0.773	<0.001	
Perceived susceptibility	Intervention	13.93±2.68	18.60±1.52	>0.001
	Control	13.74±2.64	14.07±2.74	0.303
	p **	0.544	<0.001	
Perceived severity	Intervention	16.85±2.39	27.69±2.76	>0.001
	Control	16.99±2.42	17.22±3.56	0.513
	p **	0.615	<0.001	
Perceived barriers	Intervention	19.53±5.40	10.71±3.04	>0.001
	Control	20.08±5.14	19.56 ±5.58	0.401
	p **	0.364	<0.001	
Perceived benefits	Intervention	11.95±2.09	14.20±1.14	>0.001
	Control	11.78±2.11	11.95±2.02	0.476
	p **	0.493	<0.001	
Self-efficacy	Intervention	17.63±3.24	23.19 ±2.13	>0.001
	Control	17.40±3.25	18.01±3.49	0.118
	p **	0.534	<0.001	

* t-test for between group differences; ** paired t test for within group change

Table 3. Analysis of covariance for predictors of receipt of fissure sealant.

Variables	*Pre / Post intervention*	*F-value*	*p*	*Partial Eta Squared*
Awareness	Pre	77.347	>0.001	0.207
	Post	133.386	>0.001	0.310
Perceived susceptibility	Pre	184.637	>0.001	0.383
	Post	482.704	>0.001	0.619
Perceived severity	Pre	71.109	>0.001	0.193
	Post	899.657	>0.001	0.752
Perceived benefits	Pre	204.136	>0.001	0.407
	Post	220.521	>0.001	0.426
Perceived barriers	Pre	162.617	>0.001	0.354
	Post	418.764	>0.001	0.585
Self-efficacy	Pre	148.636	>0.001	0.334
	Post	344.088	>0.001	0.537

Table 4. Logistic regression model for predictors of receipt FS based on the HBM in the intervention group.

Variables	*OR*	*95% CI*	
		Lower	*Upper*
Awareness	1.492	1.342	1.658
Perceived susceptibility	2.356	1.787	3.107
Perceived severity	1.703	1.440	2.014
Perceived benefits	1.303	1.227	1.383
Perceived barriers	0.808	0.763	0.856
Self-efficacy	1.436	1.307	1.576

intervention effective in increasing the perceived susceptibility to dental plaque (SohrabiVafa *et al.*, 2013). The different purposes of the research, demographic features, content and length of the educational intervention may be among the reasons for these contradictory findings.

Rosenstock (as cited in Ningrum, 2016) maintained that people who perceive the probability of acquiring a disease are more likely to take preventive or medical measures (Ningrum, 2016). Likewise, perceived severity can encourage preventive and medical measures in individuals (Rosenstock, 1974). In this research, parental perceptions of their child's susceptibility to caries and the severity of the condition were the strongest predictors of the child receiving fissure sealants. Thus, educational interventions could focus on this perception.

The educational intervention increased parents' perceptions of the benefits of FS therapy. Other studies have suggested the effectiveness of educational interventions in increasing the perceived benefits of having less dental plaque (Ghazanfari *et al.*, 2021; Hajimiri *et al.*, 2010; SohrabiVafa *et al.*, 2013). By contrast, two other studies reported no success from educational interventions in increasing the perception of treatment benefits (Mazaheri *et al.*, 2012; Nickbin Poshtamsary *et al.*, 2020). The intervention also reduced perceived barriers to the receipt of fissure sealants. This finding supports research where educational interventions have reduced mothers' perceived barriers to other oral health directed behaviours (Ghazanfari *et al.*, 2021; Shirzad *et al.*, 2015; SohrabiVafa *et al.*, 2013). By contrast, another study did not find a reduction in perceived barriers to oral health behaviours resulting from an educational intervention (Maryam Mazaheri *et al.*, 2012). It may be that in Mazaheri's study, the

participants did not perceive the benefits of preventive behaviours. If perceived barriers are not removed, they may become more highlighted than before.

Self-efficacy increased among participants who had received the intervention, as was the case in previous research of oral health (Ghazanfari *et al.*, 2021; Hatefnia *et al.*, 2017; Shirzad *et al.*, 2015).

The primary finding was greater receipt of fissure sealants among the children of parents who had received the intervention. Two other studies have shown that educating parents could affect their receipt of FS therapy and promoted oral/dental healthy behaviour (Halawany *et al.*, 2018; Soltani *et al.*, 2020). Contrary to this finding, in another study, although parents had high awareness of FS therapy, they did not adopt the behaviour (Lakshmanan and Gurunathan, 2020). The uptake of FS therapy in this study may have been related to several aspects of the educational intervention. First, the dentist may have spoken adequately and effectively about the topic. Secondly, the intervention was kept simple and comprehensible. The content was developed by an experienced health educationalist based on the HBM as well as the participants' comments. Furthermore, we invited parents whose children had already received FS therapy to highlight its benefits. Another facilitator was the free-of-charge FS therapy provided for the IG.

One limitation of this research was that the awareness and perception data were collected through self-reports, allowing socially desirability bias. We attempted to minimise this bias by assuring participants of the confidentiality of their responses (Wei *et al.*, 2021). However, the receipt of FS therapy was confirmed clinically. The generalisation of results to other populations or geographic areas should be made with care. Our intervention was at the personal level only and not at the contextual level. In order to change a behaviour, interventions are needed that consider both personal and contextual factors. Besides these limitations, our study had several notable strengths. It was pioneering in adopting the HBM to explore receipt of FS and prevention of dental caries in children. HBM is a systematic model to explain a healthy preventive behaviour. Our low-cost and feasible care services can be easily applied to other contexts for preventive purposes. Our research can act as a basis of comparison for future investigations that use other theoretical models aiming to raise awareness of and promote oral/dental healthy behaviors in children. We suggest similar studies in future using ecological models of health promotion to consider contextual factors that might be harder to control.

We evaluated the effectiveness of an educational intervention based on the HBM in improving parents' perception of their childrens' receipt of FS therapy. The intervention increased parents' perceptions of fissure sealants and uptake of the therapy. Thus, we can conclude that the HBM can be used to structure interventions that increase perceived threat, benefits and self-efficacy and decrease perceived barriers to promote oral/dental health. To minimise barriers to the adoption of the oral/dental healthy behaviour, researchers could develop interventions at multiple levels to go beyond the personal level.

Declaration of Interests

The authors declare no conflicts of interest with respect to the authorship and/or publication of the article.

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