A qualitative study of the implementation of a pilot school-based, toothbrushing programme

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Abstract

Background

The aim of the study was to explore stakeholders' barriers and facilitators to implement a school-based toothbrushing programme.

Methods

Focus groups and interviews were used to explore the views of elementary school students, teachers, staff, and nurses in a piloted school-based toothbrushing programme. The topic guides were developed according to the Theoretical Domains Framework (TDF) to cover the behavioural factors systematically and comprehensively. Data were analysed with content analysis.

Results

Overall, 36 students, 29 teachers/staff, and five school nurses (N=65) were included. The main theme was the importance of 'habit'. The routine and schedule in school helped children establish the toothbrushing habit. However, children did not appear to retain the dental knowledge which was taught in the programme. Instead the key factors in the implementation of the programme were providing fluoride toothpaste and toothbrush for use in schools, allowing teachers and staff to choose the timing of the brushing and engaging classmate to supervise each other is essential.

Conclusions

Implementing a school-based toothbrushing programme with the support of staff and engagement of children can help children to develop a toothbrushing habit. Further research is needed to explore ways to motivate teachers and staff to fully embrace such a programme. Classmate-supervised toothbrushing may reduce the burden of teachers and staff to implement a school-based toothbrushing programme. This paper also shows that providing suitable fluoride toothpaste rather than dental knowledge may better form children's brushing habits.

Background

Dental caries, a highly preventable disease, is the most prevalent chronic disease in children [1, 2]. Dental caries is not self-limiting, but untreated disease is common in children [3]. Toothbrushing with fluoride toothpaste has been proven to be highly effective at preventing childhood caries [4]. Ideally, home-based parent-supervised twice daily brushing with fluoride toothpaste is recommended [5]. However, for high caries-risk children or children living in deprived areas, this highly effective method may not regularly be practiced [6]. Therefore, school-based toothbrushing programmes are recommended as part of a community-based oral health promotion strategy [7]. School-based brushing programmes have been shown to be an effective caries preventive intervention [8, 9]. In the Scottish Childsmile programme, daily

supervised toothbrushing with toothpaste containing more than 1,000 ppm fluoride in nurseries and schools was found to effectively reduce caries and reduce oral health inequalities [8–10].

However, little research has been conducted into the mechanisms or impacts of these school-based toothbrushing programmes. While the daily use of fluoride in the toothpaste has a cariostatic effect, the programmes are also designed to improve children's oral health behaviours [11], including beliefs about the consequences of caries, knowledge of the importance of toothbrushing and skills in toothbrushing [11]. Nevertheless, few studies have evaluated whether such programmes are effective at changing these behaviours [12, 13] with better usage of behaviour change theories recommended in the development and evaluation of toothbrushing programmes [14].

Human behaviours are complicated and they have been addressed by many behaviour theories [15, 16]. Various theories cover different behavioural factors, and hence, these theories have different strengths and weaknesses. The Theoretical Domains Framework (TDF) is derived from 33 psychological theories. The TDF can be used to analyze problems and design interventions in a diverse and systematic way [17]. Recently, the TDF has been applied to a study of parent-supervision of toothbrushing and it is found to be an appropriate framework [18]. The TDF has also been used to identify barriers and facilitators to sexual health service use among university students and the TDF can make the analysis more comprehensive [19].

In Taiwan, the prevalence of caries is high with 65.4% of 5-year-old-children having caries experience in 2017 [20]. The mean DMFT of 12-year-old children in 2012 of 2.5 [20]. Considering the caries severity in Taiwan, the school-based toothbrushing programme was introduced and piloted in six elementary schools. Before the pilot programme is extended to other areas, an evaluation of the implementation of the programme was required [21]. Therefore, the aim of the study was to explore the facilitators and barriers of implementation of a school-based toothbrushing program with the Theoretical Domains Framework. The findings will be used to inform future implementation of the programme.

Methods

Overview

This study uses qualitative methods guided by behaviour change theory to explore the barriers and facilitators of implementation of a pilot school-based toothbrushing programme in Taiwan.

The pilot toothbrushing programme

There were six schools involved in the piloted school-based toothbrushing programme for 12 months. The students were aged six to twelve years old. These students were asked to brush twice-daily for five school days a week in the programme [22, 23].

A paediatric dentist (MCW) engaged school nurses, teachers, and staff to participate in the pilot programme. The piloted programme aimed to change children oral hygiene behaviour by enhancing the

components of COM-B model (capability, opportunity, motivation) [24]. Toothpaste containing 1,000 ppm fluoride was given to the school since most children's toothpaste in Taiwan contains less than 500 ppm of fluoride which is not as effective in caries prevention (opportunity) [25]. Dental students taught these elementary school students how to choose 1,000 ppm fluoride toothpaste and the modified Bass brushing technique (capability). Dental students also tried to motivate children to keep their teeth healthy by brushing with fluoride toothpaste in one session (motivation). The teaching activities included didactic teaching, role playing, activities, and games according to the age of children (motivation). Children could collect points by brushing twice daily. Children would get gifts if all students achieved this goal for a whole month (motivation). There was only one rule need to follow in the pilot programme, which is that these children were asked to brush twice-daily for five school days a week [22, 23]. There was no other standard protocol used, each school decided how they preferred to implement the pilot programme such as the timing of toothbrushing or whether there would be adults to supervise children brushing. The users' (stakeholders') opinions collected from this study will be used to design the formal programme.

Study procedure

The study procedure was guided by behaviour change theory, specifically the TDF and involved the following six steps [26]:

(1) Selection of the target behaviour:

In order to decrease dental caries in children, implementing the school-based toothbrushing programme was selected as the target behaviour [22, 23].

(2) Selection of the study design

Qualitative interviews were chosen to explore potential barriers and facilitators of the implementation of the toothbrushing programme from the different users' perspectives including students, school staff and nurses [26]. Focus group and one-to-one interviews were used depending on the preferences of the participants.

(3) Development of the study material

A topic guide for the semi-structured qualitative interviews was developed based on the literature about the school-based toothbrushing programme [18, 27–29], and moderated by an experienced paediatric dentist with qualitative research training (MCW and WHC), and they took notes during data collection. Open questions were designed specifically with each theoretical domain to cover the programme comprehensively [19, 30, 31]. The order in the TDF was not strictly followed to keep the flexibility for the response of participants. The topic guide was piloted with other children and teachers to ensure the questions were clear and understandable for elementary school students. All participants' unclear words or ideas were clarified in the interview directly to increase the interpretative validity [32, 33]. All sessions were audio-recorded for transcription and analysis. Ethical approval was obtained from Taipei Veterans General Hospital Research Ethics Committee (1074902348).

(4) Development of the sampling strategy

A purposive sample of elementary students, teachers, staff, and school nurses was chosen. Students, teachers, staff, and school nurses are the primary stakeholders inside the school, and they play important roles in individual, interpersonal and institutional levels. Different groups of participants were expected to bring maximum variations of the responses [26]. Participants' descriptions were collected as much as possible to increase the richness of data. Data saturation was deemed to have been reached when three consecutive participants did not provide additional ideas [34].

(5) Data collection

All the participating students, teachers and staff were invited by school nurses to share their experiences, feelings and how they would improve this toothbrushing programme. Their discussions were guided by the TDF-based topic guide. The flexibility was kept during discussion to reflect participants' daily situations [19]. Whether one-on-one interview or focus groups were arranged was determined by the school or participants' schedule. Twenty minutes was deemed the minimum to allow the participants to express their opinions. Participants' unclear words or ideas were confirmed in the interview directly to increase the interpretative validity [32, 33]. All sessions were audio-recorded for transcription and analysis.

(6) Data analysis

The data were analyzed using content analysis [35]. Coding was done by extracting meaningful units related to the target brushing behavior from the data. The codes were preliminarily grouped into barriers or facilitators. Then, the codes were categorised to 14 main categories which were the 14 domains in the TDF (Table 1) [36, 37]. Their operational definitions were derived from the American Psychological Associations' Dictionary of Psychology [36, 37]. For example, the coding rules of 'Environmental context and resources' domain could be toothpaste, toothbrushes or schedules which encouraged students' toothbrushing behaviour. The codes might be allocated to one or more domains according to their meanings [26].

Table 1

Main categories, domains from the Theoretical Domains Framework [36], in the content analysis of the barriers and facilitators

TDF domain (Main Category)	Definition	Barrier from interview	Facilitator from interview
Knowledge	An awareness of the existence of something	<i>"Someone came to teach us about brushing. But I don't remember exactly the name of the method of brushing... Something that starts with a B.... We watched a video about it" – Student</i>	<i>"The story book told us that brushing daily can prevent teeth from decaying." - Student</i>
Skills	An ability or proficiency acquired through practice	—	<i>"I want someone to confirm whether I brush properly or not." - Student</i>
Social / professional role and identity	A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting	<i>"School is a place for education. There is something needing to be covered in each session. In addition to oral hygiene issue, there are also drug issue, physical education. ... Students need to apply what they have learned. They should brush themselves at home, instead of doing everything at school" - Teacher</i>	<i>"What said by teachers to children is very influential." - Deputy head teacher</i>
Beliefs about capabilities	Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use	<i>"It may be too difficult for children under 7 to do it (flossing) by themselves, but children above 8 could give it a try." - Teacher</i>	<i>"The problem with brushing skill can be solved by teaching in lectures. The difficulties in children's brushing skill can be managed by teaching sessions. Children are all trainable." - Teacher</i>
Optimism	The confidence that things will happen for the best or that desired goals will be attained	<i>"I will continue to brush when I become a junior high school student, but I may not be able to brush in the morning." - Student</i> <i>"Brushing twice daily does not place much burden on schools." - Deputy head teacher</i>	<i>"Children do not think about whether they brushing properly or not. Children usually think they know how to brush, and they are brushing pretty well." - Teacher</i>

TDF domain (Main Category)	Definition	Barrier from interview	Facilitator from interview
Beliefs about consequences	Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation	<i>"If I do not brush, I am afraid that I will have cavities. However, I have no idea what would happen if I have cavities."</i> -Student	<i>"I am afraid that my teeth may get yellowish or decayed. This makes me want to brush after eating."</i> - Student
Reinforcement	Increasing the probability of a response by arranging a dependent relationship, or contingency between the response and a given stimulus	<i>"Children can get gifts as they brush. However, I am afraid that children will only brush when they can get gifts later in life."</i> - Teacher	<i>"The red thing (disclosing agent) looks funny, we can have a competition with gift about it."</i> - Student
Intentions	A conscious decision to perform a behaviour or a resolve to act in a certain way	<i>"Sometimes, I am so tired during the lunch break so I do not brush."</i> – Student <i>"The reason of skipping brushing is slacking off."</i> – Teacher	—
Goals	Mental representations of outcomes or end states that an individual wants to achieve	<i>"Brushing twice a day to gain points for gifts can be implemented well by children. However, the reason of brushing became the gifts."</i> – Teacher	<i>"I want to brush even more, if I can collect the points for gifts."</i> - Student
Memory, attention and decision processes	The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives	<i>"I do not remember that there were people (dental students) who came to teach us brushing."</i> - Student	<i>"When I buy toothpaste, I occasionally want to buy the one I got from school."</i> - Student
Environment context and resources	Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour	<i>"There are only 5 minutes in the other two breaks in the morning. Students do not have enough time to brush."</i> - Teacher	<i>"Students would not spend money buying oral hygiene kit, but they would use it if the kits were provided free."</i> - Teacher

TDF domain (Main Category)	Definition	Barrier from interview	Facilitator from interview
Social influences	Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours	<i>"My parents remind me to brush all the time, but they do not brush with me."</i> - Student	<i>"One student would get another student to brush. They would remind each other to brush."</i> - Teacher
Emotion	A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event	<i>"It should be not too embarrassing to brush in front of classmates."</i> – Teacher	<i>"It is fun to see other people brushing."</i> – Student
Behavioural regulation	Anything aimed at managing or changing objectively observed or measured actions	<i>"We won't remind each other to brush during winter and summer vacation."</i> - Student	<i>"The brushing song (which reminds children to brush) would be played at the brushing time"</i> - Teacher

The coding was carried out by WHC. Codes were categorized into different domains by MCW and WHC with discussion with ZM to establish consensus [38] and reduce the interpreter bias [39].

Results

Overview of the participants

Our participants were recruited from the six schools involved in the pilot programme who had implemented the toothbrushing programme for at least three months. We conducted 11 focus groups and 11 interviews, including 36 students, 29 teachers and staff (including 3 deputy head teachers and 1 principal), and 5 school nurses (N=65).

The barriers and facilitators of implementing the toothbrushing programme were reported according to the 14 domains in the TDF (Table 1).

Memory, skill, knowledge and beliefs about the consequences in children.

The results from the domains of memory, skill, knowledge and beliefs will be described together as these related closely to each other.

The barriers of memory domains were: children could not remember what was taught by the dental students, and children even forgot the dental students had come to teach them toothbrushing within two months. Even though the dental students taught children with cartoons, role playing, playing games and used different techniques, this did not help the children remember. Memory process of children perhaps was difficult to manage through teaching dental knowledge and brushing skill by dental students in just one session. Nevertheless, children did have some dental knowledge and brushing skill which was taught by their teachers who children meet every day. Elementary school teachers may know better how to make these children remember and understand things.

"It is good to have college students to give dental education, but the children did still forget after a while."

– Deputy head teacher

Professional Role And Priorities About The Toothbrushing Programme

Some teachers and staff did not think it was their job to prevent dental caries, and that their professional role was educating students. Consequently, these teachers and staff may have prioritised other activities and be less likely to integrate the toothbrushing programme into the school schedule. Students may also have other priorities that make them miss their brushing schedule such as sport or art activities.

"There is a set time to brush at lunchtime but there is no such time in the morning. Students need to tidy the classroom, read and eat breakfast." – Teacher

"Some children just do not remember to brush. They may have other activities or plans, and this makes them forget." – Teacher

Behavioural regulation, environmental context and reinforcement of the toothbrushing routine

The programme was designed to institute regular toothbrushing thus changing children's brushing behaviours. The brushing song or bell was played at the same time every day to encourage students to form the brushing routine. The data suggested that over time teachers felt they no longer needed to supervise children and that the brushing song or bell could alone be a suitable prompt for students to remember it is time to brush. Indeed, they suggested that students began to supervise each other as the brushing routine became a habit. Going one step further, it was even suggested that children might even regulate their teacher's behaviour to let them brush.

"Children are too young, they are not yet able to understand and ,hence, motivate themselves (to brush their teeth). They go to brush their teeth as they hear the brushing song." - Teacher

"Children above eight (are old enough) and already have the habit of brushing. If they do not brush, their classmate would remind them "how come you do not brush? That is so disgusting!"." - Teacher

“Children have got used to this activity in their lives. They may even remind the teachers to let them brush when the time comes” - Teacher

Social Influence Of Classmate-supervised Toothbrushing

Children's brushing behaviour was influenced by their classmates. Data showed that classmates reminded each other to brush and indeed both teachers and children suggested children did not need to be supervised by teachers. At this age, six to twelve years old, teachers felt the children's brushing habits could be easily cultivated.

“They see the whole class are brushing so they start brushing. The most important thing is to cultivate good habits as soon as possible. It is like washing their hands after using the toilet.” - Teacher

Environmental Resources To Encourage Toothbrushing Behaviours

The data suggested that many parents did not buy suitable toothpastes or toothbrushes for their children to brush at school. Some parents forgot to buy the brushing kit when it was time for it to be replaced. It was suggested that it is easier and potentially more clinically effective to run the programme where the necessary resources of toothpaste and toothbrushes are provided to ensure they are appropriate and always available to all children.

“Students need toothbrush and toothpaste, and these need to be provided by the schools rather than their parents. Parents are sometimes not that cooperative.” – Teacher

After further analysis, habit was viewed as being key to implementation of this toothbrushing programme. School routine and schedule in the environment reinforced the habit formation which relates to the classmate-supervised toothbrushing with social influence and behavioural regulation (Fig. 1).

Discussion

The aim of this study was to explore the barriers and facilitators of implementing a pilot toothbrushing programme in Taiwan. We gathered information from the primary stakeholders in the toothbrushing programme- students, teachers, staff, and school nurses. The identification of the barriers and facilitators was guided by the TDF. Most concepts were similar across different schools though their protocols might be different. The main theme of the implementation of this programme was habit. School routine, time table and schedule could be effective to cultivate the habit.

In this study, one suggestion from all teachers was that once a habit was established, they did not need to supervise students. Some teachers in our study mentioned that teachers' professional role is to educate children rather than prevent caries in children. Teachers in a previous study suggested that the

responsibility for supervising children's brushing should fall to parents rather than teachers [40]. In our study, classmates could supervise each other to brush. Students can behavioural regulate themselves, and students did not need to be regulated or supervised by adults. The social influence among students was very effective in this toothbrushing program. Students might even supervise their teacher to let them brush when the brushing time was coming. Therefore, students were perceived as no longer taking a passive role in the toothbrushing programme. Classmate-supervised toothbrushing revealed the significance of the behavioural regulation and social influences domains.

In the environment domain, the provision of brushing kits as part of the programme is important. Most children's toothpastes in Taiwan market do not contain more than 1,000 ppm fluoride. In this study, many teachers and nurses mentioned that parents did not provide the suitable toothpastes for their children to brush at school. It may imply that these children also do not have effective toothpaste at home, either. Hence, it may be more practical to provide suitable toothpaste at school provided by the programme directly. In a UK study, parents with high-carries-risk children mentioned that free toothpaste and toothbrush benefitted their families and the cost of toothbrushes and toothpaste was a potential barrier to regular toothbrushing. Providing brushing kits is recommended to help schools establish effective children's toothbrushing [41].

Motivation for toothbrushing for this young age group can be difficult but it is potentially a good time developmentally to cultivate a toothbrushing habit [42]. In this pilot programme, we tried to teach the students the potential benefits of brushing and consequences of not brushing. However, it appeared this dental knowledge did not make children have the motivation to brush. However, we did find the students easily got used to the brushing habit when brushing time was established in the school schedule (environmental context and resources domain). Children's routine is to brush as the brushing song played (reinforcement domain), and not for healthy reason (knowledge or beliefs about consequences domains). Habit is what makes children change brushing behaviour (Fig. 1).

Studies have shown that dentists visiting school settings to teach students or pure dental education may not be effective [22, 43, 44]. In this study, children do not remember what dental knowledge was taught by dental students. Children did not even remember that there were dentists or dental students who came to teach them. However, children did remember how their teacher taught them about brushing (knowledge or memory, attention and decision processes domains). Teachers understand how to design sessions to teach students better and have the opportunity to reinforce the knowledge and skills regularly. The literature also suggestions that dentists are needed to provide teachers with evidence-based dental knowledge but do not need to teach students directly [7, 44]. Dentists' role is providing teachers with accurate knowledge to prevent teachers gathering wrong information or providing outdated knowledge (social/professional role and identity domain) [7, 45].

The routine brushing time was key to habit formation, and this also made it easier for these students to develop the habit of brushing regularly and consistently. Previous papers have also mentioned that brushing should take place daily, fitting into the schedule when it is most convenient for the classroom schedule.[46] In the pilot programme, the teachers were able to decide which were the two feasible

brushing timings according to their own school's schedule. The flexibility of schedule decreased the inconvenience of teachers and staff, and perhaps increase the motivation of them to participate the programme. Teachers and staff are the key people to set the schedule of school toothbrushing. Some teachers and staff might not take students' oral health as their priority, and their refusal might make their students could not be enrolled in the programme. Previous papers also revealed that teachers and staff's motivation is the key to implement toothbrushing programmes.[7, 47] Hence, instead of motivating students directly, the future intervention design perhaps should consider how to motivate teachers and staff to help students developing brushing habit. This may improve further implementation or scaleup of school-based toothbrushing programmes.

This study used a convenience sampling which is a limitation of this study. The recruitment of children was done by the school nurses rather than the researchers. These children were willing to explain their ideas with researchers, and they did provide abundant information. Nevertheless, the participating children may have had better compliance and different views than their classmates. We did however try to confirm what children had said with their classmates during the interviews and focus groups to increase the interpretative validity [32, 33]. Additionally, we tried to recruit children from different schools and ages to improve the range of views obtained. We also tried to increase the validity through data triangulation so teachers, staff and nurses were all invited as primary stakeholders [48].

Conclusion

The result was analysed with the theoretical domains framework which could be used to evaluate how and why implementation succeeds or fails. This may also inspire further design accordingly [49]. Using this psychological framework could be the strength of this qualitative study because this may ensure the consistency of descriptions from participants and make them easier to be understood by a multi-disciplinary field [50]. The main theme of implementation of the program is "Habit." Habit was developed with routine, schedule and timetable in schools. Playing the brushing songs twice everyday encouraged children's brushing behaviour that recognize the importance of the environment, reinforcement, and behavioural regulation domains. Classmate-supervised toothbrushing revealed the significance of the social influence and behavioural regulation domains. Teachers and staff may prefer not to implement the programme because they have other priorities and role to take. Therefore, the domains of social role and decision processes could be the explored in the future studies to improve further implementation or scaleup of the piloted school-based toothbrushing programmes.

Declarations

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Authors' contributions

Ming-Ching Wang: Conceptualization, Methodology, Verification, Formal analysis, Investigation, Resources, Writing- Original Draft, Visualization, Project administration, Funding acquisition. Zoe Marshman: Conceptualization, Verification, Writing- Original Draft. Wei-Han Chen: Formal analysis, Investigation. Wen-Yu Shih: Resources.

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Availability of data and materials

The datasets analysed in the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Ethical approval was obtained from Taipei Veterans General Hospital Research Ethics Committee (1074902348). All adult participants provided written informed consent. All child participants provided written informed assent (Both child and parent).

Consent for publication

All participants were informed before the interview and signed a consent form which includes the scientific publication of the research results in compliance with data protection regulations.

Competing interests

The authors declare that they have no competing interests

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Figures

Figure 1

Habit is the main theme and the relative domains from the TDF to implement the school-based toothbrushing programme.

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