Exploring Parental Needs for Lifestyle Interventions aimed at Preventing Tooth Caries in Children between Zero to Five Years of Age: an Interview Study

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Abstract

Background: Preventing tooth caries in children is crucial due to its physical and mental risk factors, such as pain, nutritional deficiencies and reduced quality of life. Current support strategies for parents have inconsistent effectiveness. To tackle this, parental preferences and needs for oral care intervention are necessary and knowledge about how to support their self-efficacy is also crucial. Therefore, this research aimed to discover whether parents with children aged zero to five years prefer digital or non-digital interventions, and their self-efficacy in implementing these interventions.

Method: For this research, an interview study was conducted with parents (N=7). They had to choose between a Voedingscentrum poster and the app "Glansje & Tom". The data was analysed with thematic analysis.

Results: Nine themes were obtained. Preference for the poster entailed: "Easy to use with children", "Educational tool", "Physical intervention" and "Practical intervention". "Stimulation to brush teeth" and "Imitate the ideas included in the app" outlined the app's benefits. General needs were described by "Game stimulating behavioural action" and "Not time-consuming intervention". Finally, "Gaining comfort by not needing to take care of child(ren)'s oral health alone" emphasised parents' self-efficacy in implementing an intervention with their child(ren).

Conclusion: This research showed that a playful and educative non-digital intervention would be beneficial within the parent-child routine to prevent tooth caries. Moreover, such interventions can increase parents' self-efficacy in managing their children's oral health. These insights are useful for intervention developers and future research could explore this context with low-SES families.

Keywords: tooth caries prevention, parental needs and preferences, non-digital intervention, digital intervention, self-efficacy

Introduction

In the Netherlands, 31.6% of children aged between 1-9 years live with untreated tooth caries. A prominent risk factor for this is the excessive intake of sugar when consuming food (WHO, 2024). On an individual level, tooth caries could affect children's physical and mental well-being. Sheiham (2006) indicates that children with tooth caries were more likely to have nutritional deficiencies due to the pain and possible infections experienced while eating, therefore eating less (variated) than necessary and consequently experiencing growth and weight problems. Furthermore, untreated caries with resulting experience of pain or sleep disturbance would also be associated with a reduced quality of life for children (Fernandes et al., 2017; Sheiham, 2006). On a societal level, in the Netherlands, oral problems are ranked as the third most expensive condition for the healthcare system (VZinfo, 2022). Thus, it is of high importance to prevent and treat tooth caries to ensure children's growth physically and mentally.

Children end up having oral problems due to various struggles faced by their parents which are related to different factors. Suprabha et al. (2020) point out that parents struggle with several matters, such as a lack of knowledge about how to take care of their children's teeth and what exact materials to use for them, like what kind of toothbrush or toothpaste. Additionally, parents claim to be unsure about the extent of their responsibility and their children's capability to brush their teeth. Furthermore, the behaviour of the parents could also impact their children's diminished oral health, such as not making sure their children attend their dental appointments or planning dental check-ups less often for them, consequently worsening the children's oral health (Hooley et al., 2012). Therefore, parents need accurate knowledge and assistance in how to take care of their children's oral health.

Next to primary knowledge about oral care, the effect of diet on oral health is also crucial to take into consideration, particularly sugar intake. Moynihan (2005) explained that from childhood on, sugar intake poses a risk of causing dental caries. Moreover, their research has shown that a diet with less sugar that is helpful in diseases such as obesity or cancer would also be valuable in preventing tooth caries. Therefore, it is important to also focus on improving one's diet to improve their oral health.

It is most likely crucial to focus on developing an intervention to prevent tooth caries for children from zero to five years old, as developing health behaviours from early childhood on is essential in stimulating young children's growth and health in the long term (Arts et al.,

2022). Therefore, this research will focus on parents with children between the ages of zero and five, ensuring the right oral health behaviour from the beginning.

To provide parents with tools to prevent tooth caries in their children, different kinds of interventions could be considered. One of the possible intervention types would be eHealth, which can be defined as "the use of technology to support health, well-being and healthcare" (van Gemert-Pijnen et al., 2018, p. 7). There are many virtues of eHealth compared to non-digital interventions. For instance, Van Gemert-Pijnen et al. (2018) mentioned that it increases the impact of interventions/treatments and therefore the satisfaction of their users and quality of care likewise. Moreover, they added that eHealth could ensure behavioural change strategies are more cost-effective. As an example, an eHealth intervention could be a smartphone application, such as AICaries, which is supported by Artificial intelligence that aims at detecting dental caries in children by their parents at home and providing parents with education about their children's oral health (Al-Jallad et al., 2022). This intervention could make parents more likely to detect oral problems of their children and be able to prevent its severe consequences more in time. This way, the intervention would require relatively less healthcare expenses when oral problems are detected in their early stages compared to regular care, hence it could be cost-effective.

Aside from eHealth interventions, there are also non-digital interventions available to prevent tooth caries in children, such as posters or leaflets. An example of a non-digital intervention would be the "Gewoon Gaaf" intervention, which is a tooth caries prevention intervention tailored for children between the ages of 0 to 18 years. When a dental clinic takes part in the "Gewoon Gaaf" program, its dentists give personalised care to each child (Ivoren Kruis, 2021). The dentists calculate a risk score for each child and based on that they decide how often the child should pay a visit to the dentist, and what additional coaching they would need in learning how to take care of their teeth better (Centrum Mondzorg, 2021). Thus, the intervention strategies in oral care could be categorised into digital (eHealth) and non-digital ones.

A prevalent implementation obstacle in interventions is non-adherence, i.e. not using the intervention as it was designed at first (Sieverink et al., 2017). Non-adherence could be caused by differences in user preferences, such as when an app sends reminders to the users frequently to help them interact with the digital product and to be reminded of their end-goal behaviour, according to the Persuasive System Design (PSD) model that outlines necessary design elements for eHealth (Oinas-Kukkonen & Harjumaa, 2008). This might make the app

obtrusive for some users, leading them to refrain from using the digital intervention (Jameson, 2007), while others might appreciate the frequent reminders they receive from the app. Therefore, it is important to consider parents' input before developing and implementing an intervention in practice, as the parents' preferences and needs are crucial for their children's lifestyle change, hence for the intervention to be effective in terms of improving their children's oral care routine.

Next to parental needs and necessary elements in making an intervention acceptable, it is also important to consider whether parents would feel capable of adding an intervention to their routine with their child(ren). This would relate to the concept of self-efficacy of the Theory of Planned Behaviour (Bandura, 1982), hence the parents predicting whether they feel capable of using an intervention with their child(ren) for their oral health. Previous research suggests that positive self-efficacy could increase oral care behaviour adherence, such as flossing (Borkowska et al., 1998; McCaul et al., 1985). It also suggests that positive self-efficacy could reduce one's stress level and stimulate one to solve the stressful problem at hand (Sebastian, 2013). Additionally, Mouton et al. (2018) showed that developing programs to enhance parents' self-efficacy would be beneficial in minimising children's *externalising behaviour (EB)*, which includes behaviours hindering children's development, e.g. non-compliance, inattention, aggression, etc. that could be applicable in oral care if the child declines to listen to the parent and not brush the teeth, for example. Therefore, considering parents' self-efficacy when creating an intervention for their children's oral care would be necessary in the developmental process to ensure adherence to the created intervention and its eventual effectiveness.

To explore the parental needs for an intervention aimed at preventing their children's tooth caries the first research questions will be the following: "To what extent would parents prefer a digital or a non-digital oral care intervention to use with their child(ren) to prevent tooth caries?" with the sub-question "For digital interventions, which design elements should be included in the intervention that would make it fit their routine with their child(ren)?", as only for digital interventions a design elements model is available (i.e. PSD). The second research question will examine parents' self-efficacy in this regard: "To what extent would parents feel mentally capable of implementing an intervention in their daily life with their child(ren)?"

Method

Participants

A total of seven parents were interviewed. All seven parents identified as female within the age range of 30 to 37 years. The children's ages varied between one and five years old. Two of them had Iraqi nationality and the rest were Dutch. The sampling technique used was purposive sampling, in which the researcher conveniently recruited parents from her social environment. Merely one inclusion criterion was considered, namely that the parents should have at least one child between the ages of zero and five.

Materials

Interview Scheme

A semi-structured interview protocol was created for this study that consisted of six different concepts (See Appendix A). The interview scheme entailed asking for descriptive information about the participants, i.e. age, gender, nationality and occupation. Furthermore, several questions were included to explore the context of their child(ren)'s oral care, e.g. how do they take care of their child(ren)'s oral health, and what kind of strategies do they use for this? Additionally, the interview scheme aimed to explore what kind of recommendations parents receive from specialists, such as tips from dentists, or instructions from a specific (digital or non-digital) intervention. For the remainder, the scheme included the topic of preferences of the two provided interventions and enabled more exploration of the reasoning behind the preference and to what extent it would fit the parents' routine in terms of their self-efficacy. Each topic consisted of main open questions, with each having several sub-questions to get more information about the topic. Moreover, probes/examples were also used to help the interviewees answer the questions in case it was difficult for them to answer. All interviews were recorded using the "Dictaphone" application.

Poster

The poster retrieved from Voedingscentrum (2024b), i.e. the non-digital intervention, illustrates what the right snacks are parents could give to their children, depending on their nutritional content (See Figure 1). If it is a healthy snack with not many harmful sugars, it is included in the green area of "this is allowed every day". Snacks with a bit less sugar are in the grey area "this is allowed sometimes", and the snacks that contain a lot of sugar which is harmful to the teeth, are included in the red area of "preferably not". This intervention could help prevent parents from giving their children too many sugary snacks, leading to early tooth

caries. As most of the available non-digital interventions in terms of oral care were designed for use with dentists, the researcher chose to focus on an intervention that indirectly focuses on oral care by focusing on the diet, which could easily be used at home and therefore applied in the parent-child routine. Additionally, the poster includes snacks that are already edible by children from the age of one year old, making it suitable for the target group of this research (Voedingscentrum, 2024a).

Figure 1

Poster as Non-digital Intervention

App

The digital intervention used was the application “Glansje & Tom”. It is an educational application meant to teach children about oral care and nutrition. The application gives the possibility to create a personalised character (See Figure 2) and includes a virtual assistant, the

tooth fairy, that guides the child through the levels of games. These levels include guiding children in brushing their teeth in small and encouraging steps with the use of a timer (See Figure 3), by making use of the virtual assistant as a motivator. Furthermore, the application also includes games, such as the memory game or multiple choice questions to teach them about healthy nutrition. Thus, the application is meant to encourage children to have the right oral and nutritional habits in a playful manner (GGD Appstore, 2016).

As the app is designed for children between the ages of four and nine, it might be the case that parents with children below the age of four would not consider using this in real life with their child yet. However, showing this intervention as an example could initiate the discussion with these parents about how to make a digital intervention tailored to their child's age, ultimately gaining insights into parental needs for a digital intervention.

Figure 2

App Intro (Making Personalised Character)

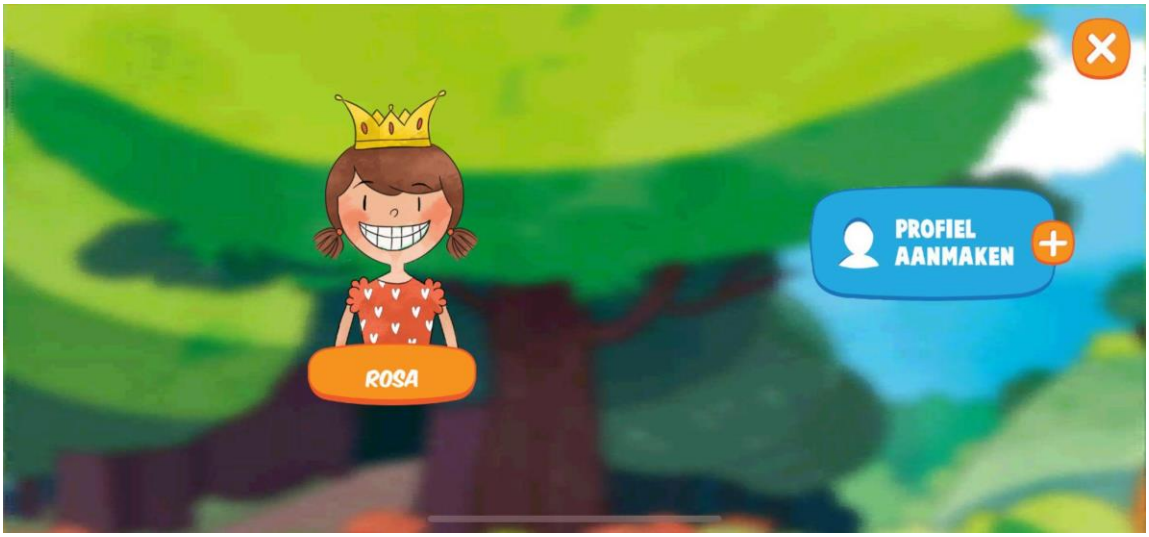

Figure 3

App Timer Game

Procedure

Before starting with data collection, ethical approval was obtained from the BMS Ethics Board under application number 240357. The researcher interviewed only one parent from each household. As a first step in each interview session, the participants were provided with an information sheet (See Appendix B) that describes the purpose of the study and how the interview will be conducted. Afterwards, the participants had the opportunity to ask questions if there were unclarities about the procedure, after which they signed the written informed consent form(See Appendix B). After they gave consent, the audio recording started and the interviewer began asking the questions mentioned in the interview protocol (See Appendix A) and made use of probing if necessary. First, the interview discussed the interviewee's characteristics, children's oral care context, and recommendations received from specialists regarding their oral care. Subsequently, they were presented with the poster and app (See Figures 1, 2 & 3) and questions were asked about their opinion and needs for the chosen interventions. Finally, the interviewer asked about the stress level and self-efficacy in applying the intervention in their daily routine and finalised the interview if there were no further questions from either side. The interviews lasted approximately 30 to 40 minutes. Afterwards, the interviews were transcribed and later translated into English as they were first conducted in Dutch. The audio recordings were deleted after obtaining the transcripts with each participant being anonymised.

Data Analysis

For this interview study, the data were analysed in Atlas.ti with Thematic Analysis (TA) (Braun & Clarke, 2006), to identify meaning-making patterns (i.e. themes) related to the research questions and sub-question. The TA analysis was based on the inductive approach, to give new insights into the parents' needs regarding oral health interventions rather than to test or align with a pre-existing theory. The six-step guideline of Braun and Clarke (2006) was used: familiarising with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes and producing the report.

First, the researcher read through all the transcripts to get insights into the data. Subsequently, the transcripts were coded by focusing on gaining insights from the data about the needs of the parents regarding using an oral health intervention, their preference for digital or non-digital intervention and the relationship between their mental effort and fitting an oral health intervention in their routine with their child(ren). Thus, the codes (i.e. sub-themes) represented the needs of parents, their respective intervention preferences, and their mental capability in applying the chosen intervention in their parent-child routine, based on inductive coding.

After generating the initial sub-themes, themes were searched for by grouping sub-themes with mutual characteristics. The final themes were obtained and presented in the results after multiple reviews and adjustments if necessary to establish the right conceptualisation and structure of the themes.

Results

Sample characteristics are visible in Table 1. All of the parents had a higher educational level than secondary school and the majority (i.e. six) were employed. The age of the parents' children varied: the sample included parents with children of one or two years old and parents with children of four or five years old.

Table 1.

Sample Characteristics

Background characteristics	Total sample		Preference poster		Preference app	
	n	%	*n*	%	*n*	%
Gender						
Female	7	100	6	85.7	1	14.3
Male	0	0	0	0	0	0
Highest educational level						
Secondary education	0	0	0	0	0	0
Secondary vocational education	2	28.6	2	28.6	0	0
Applied sciences	1	14.3	1	14.3	0	0
University education	4	57.1	3	42.9	1	14.3
Employment						
Unemployed	1	14.3	1	14.3	0	0
Employed	5	71.4	4	57.1	1	14.3
Self-employed	1	14.3	1	14.3	0	0
Age of children						
One	1	12.5	1	12.5	0	0
Two	3	37.5	3	37.5	0	0
Three	0	0	0	0	0	0
Four	1	12.5	1	12.5	0	0
Five	3	37.5	2	25	1	12.5

After performing the thematic analysis, a total of nine themes were obtained, out of which the first eight were related to the first research question and the last one to the second research question. The themes were divided into the following topics: preference for the poster, benefits of the app, general needs for interventions and the mental capability of parents.

Preference Non-Digital Intervention

The first four obtained themes related to the preference for the poster were “Easy to use with children”, “Educational tool”, “Physical intervention” and “Practical intervention” (See Table 2).

Easy to Use with Children

The parents who chose the poster noticed how it is designed for children so they can use it. The most noticeable element in this case was the use of smileys in the poster. Parents were also fond of the use of pictures of snacks and the use of different colours in the poster.

Regarding the first sub-theme, “Use of smileys” (N=6), all parents who preferred the poster appreciated the smiley face element as it makes it easier to use and explain to their child what the good and bad snacks are. One of the parents, A.(30) mentioned that “*simply with these smileys it is shown what is good and what is less good, I think my child can understand a happy and not happy face* ”. Therefore, the use of smiley faces was the most preferred element of the poster because of its simplicity in clearly transferring health advice to children.

As for the sub-theme “Use of pictures” (N=3), parents liked the idea of displaying snacks with pictures so the children could recognise the snacks categorised in the three different sections. One parent, N.(31) clarified about her child that “*because he also likes pictures and this way he can get explanations and see things like ‘oh yes, so that is why I usually get fruit and vegetables often and gingerbread or a rice waffle very occasionally’* ”. Therefore, the use of pictures was considered beneficial by some parents as it would be useful for their children to recognise the snacks they are eating and why they are eating them and not other (unhealthy) snacks as often.

Finally, some parents found the inclusion of different colours (N=2) around the snacks clever, i.e. green around healthy, grey around occasionally edible snacks and red around unhealthy snacks. One parent, P.(37) described how the child could perceive the poster based on the colours: “*This is a smiley, a green smiley, I can eat that every day*”. Thus, the colour system was also a reason for some parents to favour the idea behind the poster.

Educational Tool

Another reason why parents favoured the poster was the possibility of using it as an educational tool for their children. Some parents said to be able to explain to the child the concept of healthy and unhealthy snacks and their influence on their teeth (N = 3) and one parent also saw the poster as a way to do exercises with her child.

The first sub-theme "Explanation" refers to the idea that parents found it possible to use the poster as a tool to show that "*this is a good snack to eat*", said one parent, S.(34), and to explain further to their children what the purpose of eating healthy snacks more often is, namely preventing them from getting tooth caries. Therefore, by some of the parents, the poster was considered as a strategy to teach their children more about the importance of the connection between nutrition and oral health.

Additionally, one of the parents, C.(36) considered the poster as a means to exercise with her child "*What is this snack called?*", for her child to get more acquainted with the sorts of snacks, making it an educational tool. Hence the sub-theme "Exercise". She preferred to do such an exercise with something non-digital, as doing this digitally would be "*too fun*" for her child and therefore perhaps not that effective.

Physical Intervention

The theme of physical intervention refers to the fact that some parents liked the poster more because as C.(36) mentioned, "*You really see it*", and as A.(30) mentioned, "*This is something you could watch continuously, but you do not always have the app on*". Thus, they supported the physical presence of the poster. Three parents were more appreciative of the physical presence of the intervention as they wanted their children to have as little screen time as possible: "*I'd rather keep him away from videos and games as much as possible*" said N. (31), hence the sub-theme "as little screen time as possible". Interestingly, two of these three parents liked the ideas included in the app and imagined themselves using them. An illustration of the physical application of the app's ideas according to N.(31) would be the following: "*So what I might do is watch the app itself, then teach myself what is said in terms of information, and then not show the video but I would do it myself so to speak*". Therefore, once again, the sub-theme "Physical application of the app's ideas" stressed the importance of the physical presence of an intervention. Otherwise, even if the digital intervention would include beneficial ideas, they would not use it because it is digital, hence because it involves screen time for the child.

Practical Intervention

Most of the parents who chose the poster were also fond of its practicality in their daily routine with their children, either because one could hang it somewhere in the house (N= 4), or because it could be memorised better (N = 2). P.(37) explained the former sub-theme in the following way:

> I think especially for children if you were to just stick this somewhere on the wall, in the kitchen, near the refrigerator or something. And then next time they ask again, 'Can I have a doughnut?', then you say 'No, look we had this yesterday'.

In the case of the latter sub-theme, A.(30) argued that the child could see the poster more often compared to the app as mentioned above. Therefore, the child "*can remember it more, so to speak*", because they cannot use a screen as often as they would see the poster in their house.

Table 2.

Themes regarding Parents' Preference for a Non-digital Intervention.

Theme	Description theme	Sub-theme	Frequency sub-theme	
			n	%
Easy to use with children	The elements used in the intervention (smileys, pictures and colours) make it achievable to use with children.	Use of smileys	6	85.7
		Use of pictures	3	42.9
		Use of colours	2	28.6
Educational tool	The intervention serves as a tool to educate and exercise with the child about the connection between nutrition and oral health.	Explanation	3	42.9

		Exercise	1	14.3
Physical intervention	A physically visible intervention is better suited for use with children.	Live perception	1	14.3
		Ability to see it continuously	1	14.3
		Physical application of the app's ideas	2	28.6
		As little screen time as possible	3	42.9
Practical intervention	A non-digital intervention could be displayed somewhere in the house and this way it would not be forgotten easily.	Hang it somewhere in the house	4	57.1
		Remember it better	2	28.6

Benefits Digital Intervention

Regarding the digital intervention, no meaning-making patterns were found as a preference for the app, as only R.(36) preferred it over the poster. However, themes were found in terms of benefits that one could gain from a digital intervention, i.e. "stimulation to brush teeth" and "imitation of the app's ideas to prevent screen time" (See Table 3).

Stimulation to Brush the Teeth Well

The first theme about the digital intervention's benefits involves enhancing children to brush their teeth well. The sub-themes are "Reduce resistance", "Reduce insecurity" and "Make a game out of brushing teeth". C.(36), who preferred the poster over the app, mentioned the following:

> I find the app a bit game-like and then I wonder whether the goal is achieved with the app. But suppose you have a child who really dreads brushing their teeth, and who does not like it at all, or who always starts crying, then the app might be fun. Maybe it also depends a bit on what your child is like.

She pointed out that her child might not take the app seriously to the extent that it would motivate him to brush his teeth because of it. However, a funny game could benefit a child who resists brushing their teeth and is in a certain way scared of it, hence the sub-theme “reduce resistance” (N = 1).

Moreover, the app could also increase the child's confidence in brushing their teeth well, resulting in the sub-theme “reduce insecurity” (N = 1). R.(36) mentioned that one of her older children had to go to the dentist because of a cavity in his teeth, which made all three of her children doubt themselves whether they were brushing their teeth well and started to get scared of also getting cavities. R.(36) continued saying: “*I think this app will really help them to gain confidence for next week’s dentist appointment* ”. In this case, the children would be more sure that they did not forget a part of their teeth to brush (e.g. the teeth below), as the virtual character mentions them all in order. This way, the app would help the children gain confidence about their oral care.

The last sub-theme would be “make a game out of brushing teeth” (N = 2). For instance, P.(37) liked the idea of the app because of how “complete” it was by including a teeth brushing exercise and quiz about nutrition. She also said that

> Parents who have less difficulty with using the telephone, this could work quite well. It was enticing, attractive too, with colour and sound. That appeals to children, and if you can get the child to brush their teeth in such a playful way, then I think it can really work.

She saw the benefit of the app in how playful it was designed for children, as she also already made brushing her child’s teeth in a fun way by taking roles in brushing it (ten seconds the mom brushes the child’s teeth and then ten seconds the child brushes the teeth herself). Therefore, although the digital intervention was not preferred by the majority, some of the parents did not completely disregard it.

Imitate the Ideas Included in the App to Prevent Screen Time

Using the ideas of the app as inspiration to apply it physically as a parent was something N.(31) and P.(37) were willing to do. They both explained that they see how effective the intentions of the app could be, however, they would not use it because it is displayed digitally. N.(31) and P.(37) both appreciated what the virtual character told the user in terms of information. For example, as P.(37) said, " *I really liked the information that appeared in the text, so to speak: 'Brushing your teeth gives you white teeth'. And also a funny name, Glansje*". Therefore, the sub-theme "the content included in the app" was obtained (N = 1).

Lastly, the sub-theme "timer exercise" was acquired as two parents appreciated the teeth brushing exercise with the aid of the virtual character. P.(37) suggested the following:

> Well personally, if you were to give me the poster, and you would also add an hourglass or some other way of keeping track of the time and another nice piece of paper with some playful information or drawings about why it is important to brush your teeth, then I would choose that.

Hence, the content of the digital intervention was appreciated by some parents, but due to the screen time factor, it was preferred to apply these ideas non-digitally.

Additional Insights about the Preference for a Digital Intervention

As mentioned above, only R.(36) chose the digital intervention over the non-digital one, hence no meaning-making pattern was possible to find. However, regardless of this fact, the crucial insights from this participant were included to present valuable information about why the digital intervention could be preferred.

First, she perceived the app as an intervention that could be applied with little effort. She also recognised the positive and consequently motivating attitude of the virtual characters. Moreover, as her older children have used another digital intervention and it has been successful previously, she was motivated to use this intervention with her younger child. Additionally, she complimented the app for the timer exercise, overlapping with the sub-theme "timer exercise" obtained from parents who did not prefer the app, and the game about choosing healthy snacks, making them more involved in oral health. She even suggested adding a suggestive function, to

allow the parents to order “plaque detector pills” via the app, which are pink tablets one could chew on and after rinsing the mouth if pink areas are left on the teeth, that would indicate that there is dental plaque left on the teeth, hence the teeth should be brushed better. Thus, the participant was fond of the digital intervention and even saw possible future advancements in the app.

Lastly, as she was the only participant who preferred the digital intervention, she was the only one who provided information about what design elements she liked and would need in a digital intervention. She found the sound of the virtual character appealing as it sounded like someone who guides the user through the tooth brushing process kindly. She also complimented the app for its attractiveness: “ *It looks attractive. Happy colours. That cattle is of course nice, that wand and the teeth are very big. The mouth opens very wide and that of course looks a bit funny. I think children really like that* ” (See Figure 3). The participant did not see a need for improvement regarding the design of the intervention. Thus, the participant appreciated the design of the app for its elements that are appealing to its users, hence to children.

Table 3.

Themes regarding Benefits of the Digital Intervention

Theme	Description theme	Sub-themes	Frequency sub-theme	
			n	%
Stimulation to brush the teeth well	The app tackles obstacles that could intervene in brushing the teeth well (resistance or insecurity) and makes tooth brushing a fun activity to do.	Reduce resistance	1	14.3
		Reduce insecurity	1	14.3
		Make a game out of brushing teeth	2	28.6
Imitate the ideas included in the app to prevent screen time	Although the digital intervention is not preferred, its content still inspires parents to apply it in real life.	The content included in the app	1	14.3
		Timer exercise	2	28.6

General Needs for Interventions

Apart from choosing a digital or non-digital intervention, parents mentioned their general needs for an intervention focused on tooth caries prevention to use with their children. The two themes/needs were “Game stimulating behavioural action” and “Not time-consuming intervention” (See Table 4).

Game Stimulating Behavioural Action

The most prevalent need from parents was for an intervention to be designed playfully (N = 4). This would motivate the children to not resist brushing their teeth, for example, or to take the two minutes completely to brush their teeth carefully. As N.(31) explained, "*Sometimes, my child is really in that mode where he really does not want to brush his teeth. Then it might help to lighten it up a bit and make it fun instead of being strict*". Parents stressed this need because they do not want their children to associate tooth brushing with a negative or scary experiment: they do not want to scare them with the expression "If you do not brush your teeth well, you will get tooth caries and will need to be treated by the dentist" which might result in them becoming scared of dentist visits. Thus, parents suggested a playful intervention to be the most suitable approach to use with their children.

In the case of the sub-theme "Positive tone" (N = 1), R.(36) gave an example of a positive and negative alternative of an expression: "*If you do it this way, you are doing it right*" as the positive one and "*If you do not do this, then it is not good*" as the negative alternative. She explained that the positivity in the expression is crucial, making the child more motivated to take the suggested behavioural action. Therefore, a positive tone would be necessary in an intervention.

Not Time-consuming Intervention

P.(37) specifically mentioned the struggle of having little time to manage brushing her child's teeth two times a day. Therefore, she stressed the need of an intervention that would take less from her rather than consume her time even more, resulting in the sub-theme "Quick" (N = 2). Moreover, R.(36) also explained that "*We are all busy, we all want fast, fast* ", which is why she saw the need for an intervention that is not so time-consuming.

Table 4.

Themes regarding Parents' General Needs for an Oral Health Intervention

Theme	Description Theme	Sub-themes	Frequency sub-theme	
			n	%
Game stimulating behavioural action	A positive game tailored for children to stimulate brushing their teeth.	Playful manner	4	57.1
		Positive tone	1	14.3
Not time-consuming intervention	The intervention should not require more time than it already takes from parents to take care of their child(ren)'s teeth.	Quick	2	28.6

Mental Capability of Parents

The last theme was related to the question of whether they feel mentally capable of implementing an intervention focused on preventing tooth caries in their children. Based on the answers the parents gave, the theme "Gaining control by not needing to take care of child(ren)'s oral health alone" was obtained with the sub-themes "Shared responsibility" (N = 3) and "Feeling less powerless" (N = 1) (See Table 5).

Gaining Comfort by Not Needing to Take Care of Child(ren)'s Oral Health Alone

As mentioned above, P.(37) struggled with brushing her children's teeth two times a day, which made her feel responsible for the possible negative consequences, e.g. tooth caries. She admitted stressing more about her older children (six and ten years old) rather than about her two-year-old as the youngest child still had baby teeth. However, having an intervention that would support her in managing tooth brushing twice per day would make her feel that she

is "*not alone in this*", as she mentioned, and consequently would feel less stressed about her children's dental care. Furthermore, R.(36) said that implementing an intervention in their daily routine would reassure her that her children would be taught about oral care the way she and her partner were teaching them. Therefore, the shared responsibility that would take place (the intervention and parents) would provide parents with reassurance regarding their children's oral health, hence the sub-theme "shared responsibility".

N.(31) struggled with her child resisting tooth brushing sometimes, which made her feel like she was losing control over the behaviour of her child. By having an intervention as a support, she mentioned that her sense of control would be increased, leading her to feel more capable of taking care of her child's teeth and less powerless as a parent:

> I can imagine that it helps to lower the stress level, so to speak, in the sense that I have something physical to fall back on, to deploy, to use, to try and then see what it does. So that alone makes me feel a lot less powerless and then I know 'Okay, there is something I can use to inform my child and perhaps things will go better.

Therefore, the sub-theme "Feeling less powerless" was obtained. Overall, only two parents were genuinely struggling with and experiencing stress about their children's oral care routine.

Table 5.

Themes regarding the Mental Capability of Parents

Theme	Description theme	Sub-theme	Frequency sub-theme	
			n	%
Gaining comfort by not needing to take care of child(ren)'s oral health alone	The extra support that parents get from (professional) interventions makes them feel more confident in taking care of their child(ren)'s teeth.	Shared responsibility	3	42.9
		Feeling less powerless	1	14.3

Discussion

Summary of Main Findings

To summarise the obtained results and answer the research questions, parents preferred the non-digital intervention to use with their children (N=6), as it includes elements that make it easy to use with children. Moreover, according to the parents, the poster could serve as an educational tool about oral health. Lastly, the parents also valued the poster because of its physical presence and practical values.

Although the poster was preferred, the digital intervention was also valued for its function of stimulating children to brush their teeth in case they are resistant to it, or insecure about their capability to brush their teeth. The app made brushing teeth a fun activity, according to the parents and the educational game about diet was also likeable. Furthermore, parents said that they would apply the app in real life, as they prefer to prevent their children from having screen time. In terms of general needs for an intervention, regardless of it being digital or non-digital, it would be having a game with a positive tone that stimulates tooth brushing, but one

that does not require more time than it usually takes for parents to take care of their child's teeth.

Additionally, regarding the sub-question about the design elements in the digital intervention, it could be said that a necessary design element was to include visually attractive and audibly kind characters that would invite the children to use the intervention with their parents. Finally, in terms of parents' self-efficacy in applying an intervention in their routine with their children, it was found that if parents get support from professional interventions, it would make them more comfortable and confident in taking care of their child(ren)'s teeth. The intervention would need to give them reassurance in not taking care of their child(ren)'s oral health alone. Thus, if the intervention gives the reassurance they need, they would more likely implement it in their daily life routine with their child to benefit from it.

Discussion of Main Findings

Considering the obtained results about the preference for the non-digital intervention, similar insights have been found in previous literature. Research conducted by Shirahmadi et al. (2024) demonstrated that creating interventions to stimulate oral health behaviour in elementary school children would be effective when it includes educational tools in the form of games, videos or pamphlets. Particularly a game as a method proved to be effective in retaining the learned knowledge about oral care and improving their behaviour accordingly. This would align with the parents' need for an intervention to be in the form of a game that could also be used as an educational tool, confirming the necessity of a gamified educative intervention as a general need.

However, the intervention program of Shirahmadi et al. (2024) communicated the educational knowledge digitally, i.e. with a Telegram group, and the game was also digital, which was not disliked by the parents. This would contradict the preference of most parents in this research to have a non-digital intervention. A possible explanation for this would be that the difference in the inclusion criteria: the children's age range for Shirahmadi and colleagues' (2024) research was between 11 and 12 years, while the parents of this research were parents of children from the ages zero to five. Parents of this research would more likely ensure as little amount of screen time as possible for their children based on their relatively younger age (Nederlands Jeugdinstituut, 2024; Ouders van Nu, 2023). This would also relate to the reasoning that parents can control the amount of their screen time more when they are younger

than when they get older (Lauricella et al., 2015). Additionally, a digital intervention could even disrupt their children's routines in the context of daily oral care (Bhatti et al., 2021). Therefore, parents preventing as much screen time as possible for their children could be a drawback to using digital tools in an intervention for their children.

Consequently, more research would be necessary to find out to what extent intervention designers could develop a non-digital lifestyle intervention to meet their need for a physical and practical intervention, as in the current available non-digital interventions dentists are more actively involved than the parents (Ivoren Kruis, 2021), making them less of a lifestyle intervention.

Concerning the acquired results about PSD design elements, these would align with the element "Liking"(Oinas-Kukkonen & Harjumaa, 2008) as the visual and audio attractiveness of the app would be capable of attracting children to use it, according to the one participant who preferred the digital intervention. In the systematic review conducted by Silva et al. (2023) about defining the PSD model and Behaviour Change Technique Taxonomy (BCTT) elements in terms of eHealth interventions for parents, it was noted that "Liking" was used in digital interventions, although on average less often when compared with other design elements, such as the elements "Suggestion" or "Reminder". Therefore, for parents who would prefer a digital intervention, more in-depth research would be necessary to define the key PSD elements that they would need in a digital intervention, as their input would be crucial in developing and implementing an effective intervention (Van Gemert-Pijnen et al., 2018).

With regards to the parents' self-efficacy in including a lifestyle intervention to prevent tooth caries in their parent-child daily routine, it could be said that the extra support and reassurance received from interventions would make them self-predict more positively in applying it to their parent-child oral care routine, which could consequently reduce their stress level in case they were experiencing any (Sebastian, 2013). Moreover, in the long-term, if including the intervention in their daily routine is successful, it could result in the right oral care behaviour adherence (Borkowska et al., 1998; McCaul et al., 1985), e.g. brushing teeth twice a day. This would highlight the importance of giving extra support to the parents who require the reassurance of not taking care of their children's oral care alone.

Interestingly, in this research, only two out of seven parents mentioned struggling with taking care of their children's oral health. This could be clarified by the little knowledge gap the interviewed parents had: they have received sufficient advice from parents, professionals

and other mothers in their social circle. For instance, one of the reasons why children with low SES have poor oral health and are more likely to have tooth caries is the little education their parents had or were possible to obtain regarding oral care (Almajed et al., 2024; Anil & Anand, 2017). Thus, it could be necessary to explore the stress and struggles low SES parents face in terms of taking care of their children's oral health and possibly what their needs are, in this case.

Strengths and Limitations

This research naturally comes along with its strengths and limitations. First, the data obtained from the interviews would be considered rich in context, as the data collection method was a semi-structured interview, which allowed the participants to answer the questions openly and with some flexibility, leading to a deeper understanding of the parents' need from an intervention for their children's oral care. Simultaneously, because the data collection method was a semi-structured interview, the researcher was also provided with some structure to be able to compare the data of the different participants (Harrison & Rentzelas, 2020).

Concerning the research's limitations, it could be possible that the researcher influenced the participants' answers more when they needed probing, as probing could lead to obtaining selective rather than complete answers, which could consequently affect the accuracy of the results. Moreover, the researcher's subjectivity during the analysis might have affected the final themes that were gained, resulting in a deviation from what the participants meant to say. On the other hand, one must keep in mind that one of the qualitative research's necessities and strengths is the interpretation of the researcher, to gain new insights about a certain concept (Willig, 2019). Hence, the researcher's subjectivity could be a strength and a limitation.

Another limitation of this study would be that the sample size of this research was not big enough to take generalisable conclusions. Themes obtained from merely seven participants cannot yet be indicative of valid and reliable results. However, they could be rather the stepping stones to continuing this research on a larger scale, considering the importance of parents' insights in developing an intervention that would be used by them (van Gemert-Pijnen et al., 2018; Timmers et al., 2022).

Lastly, the respective interventions that were shown to the parents during the interview might have not been the ideal combination to show. As some parents noticed, the poster focused

on nutrition, while the app focused on tooth brushing and partly on nutrition, making them not completely comparable interventions in terms of content. On the other hand, the reason why parents preferred the poster was because of its physical presence and practicality, which was also simultaneously the reason why they did not prefer the digital intervention (i.e. because it was digital). Thus, the interventions not being comparable in terms of content might have not negatively affected the results of the study.

Recommendations for Future Research

For future research, a suggestion would be to extend this research to different groups of people, such as parents with low SES, to explore what kind of preferences and needs low SES families would have for lifestyle interventions to enhance their children's oral health behaviours. This would be valuable because a review conducted by Almajed et al. (2024) shows that low SES is associated with child oral health problems, of which the influence factors are the education of the parent, their income, and their own "early-life socioeconomic disadvantages" (p.7), amongst others. Thus, more research would be necessary to tackle these influencing factors according to the preferences and needs of low SES parents.

Furthermore, it would also be valuable to find out why low SES parents experience stress from their children's oral health and what kind of support would help them decrease it and increase their self-efficacy instead. This is because research has indicated that stress among parents deteriorates children's oral health (Renzaho & De Silva-Sanigorski, 2013) and because increasing one's self-efficacy is considered one of the ways to decrease one's stress level (Sebastian, 2013). Therefore, more research about the needs of low SES parents from lifestyle interventions to reduce their stress levels regarding their children's oral health would be necessary.

In general, another suggestion would be to expand this interview study by including a larger sample size, to increase the validity and reliability of the obtained results. Eventually, because this research partly focused on the specific preference between digital or non-digital intervention, a larger sample size would be more representative of this specific preference in parents. Therefore, a larger sample size with this interview study would ensure more verified results.

Implications

This research has set the first steps in exploring the preferences and needs of parents for an intervention that would be developed for them to use with their children to prevent tooth caries. As intervention developers, it would be beneficial to know what kind of interventions parents prefer, digital or non-digital, to focus on developing an app or a poster, for example, based on this preference.

Moreover, this research collected information about elements that make an intervention feasible to apply in the parent-child routine, giving intervention developers more insights into which elements they should include in the potential intervention in terms of what role it needs to have in their routine, making it meet the requirements of the parents, decreasing implementation barriers and creating an effective intervention, eventually (Van Gemert-Pijnen; Timmers et al., 2022). Therefore, children's oral care intervention developers could make use of these insights in their developmental process for a lifestyle intervention that should be created to prevent tooth caries in children between the ages of zero and five.

Conclusion

In conclusion, this research underlined the importance of developing playful and educative lifestyle interventions for parents to use with their children between zero and five years old to prevent them from having tooth caries. It also stressed the need for a non-digital intervention from which children could benefit due to its physical presence and from which parents would value the reassurance of having a shared responsibility and extra support in taking care of their children's oral health.

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Appendix A

Interview Scheme

Characteristics

What gender do you identify as?

What is your age?

What is your nationality?

What is your occupation/study?

- Do you work full time/part time, other?

How many children do you have and what are their ages?

Exploration of context

How do you take care of your child(ren)'s oral health?

- Checkups at dentist? How often?
- Other?

How do you support your child(ren) in taking care of their teeth?

- Brushing their teeth? How many times a day?
- Helping them to brush their teeth themselves?

Any extra support/strategies you use/have used in guiding them to brush their teeth and/or to make a habit out of it?

Nutrition strategies?

- Eating schedule: three meals a day? With how many snacks?
- Max. amount of sugar intake per day?
- Not eating/drinking after brushing their teeth in the evening?
- Other?

How did you learn about how to take care of your child(ren)'s oral health?

Do you experience any issues with your routine in taking care/supporting of your child(ren)'s oral health?

- If so, could you specify the struggle?
- Have you tried a certain strategy to solve it?
- What would be helpful for you in this case? What kind of support would you need and why?
- How much stress do you experience as a parent?
- Does thinking about oral care of your children affect your stress levels? Positive or negative?

Recommendations/interventions from specialists?

What interventions/recommendations do you know in general, digital or non-digital? Any examples?

- Where did you get this recommendation?
- Did you make use of them? Why/why not?
- Did anything stand out as positive/negative regarding the intervention(s)/recommendation(s)?
- Are instructions/tips clear? Easy to follow/understand?

Do you look for information regarding your children's health/ healthy lifestyle?

- What kind of information?
- Where do you look for them? (Books, news, internet, etc.)
- How did you learn about it? (online, tv, news, friends, etc.)

Physical examples of interventions to ask them about their opinion on it, specifically about acceptance, needs, etc.

First let them choose out of the examples (poster or app, see poster below):

"I have two examples of interventions here, a poster and an application, which one would you prefer to use with your child?"

Poster → Voedingscentrum
The app → Glansje en Tom

Then they can get more explanation about the chosen intervention if necessary or can explore the intervention more.

- The poster gives an overview of what the healthiest snacks are for children, to prevent too much sugar intake that would damage their teeth.
- "The Adventures of Glansje & Tom" aims to teach children about **dental care and nutrition in a fun way**. Each day, knowledge is shared in a playful manner that connects with the child's world. **Repetition and the use of games help children become aware of good dental care habits**. Their behavior, such as **brushing teeth** and **eating habits**, is influenced by encouragement, small steps, constant rewards, and role models like the adventurous princess Glansje with her shiny teeth. The app is part of a complete **communication and prevention concept including dental care fairy tales**, brushing certificates, coloring pages, and brochures about nutrition and fear of the dentist, along with the Glansje fear glasses.

Then, questions:

- Is the idea of the intervention clear to you? If so, could explain what you understood from it?
- Do you see yourself using this (with your kid)? Why or why not?
- What do you like/dislike about the app?
- What do you think about its functions?
- Do you think the intervention is useful? Why or why not?
    - What do you think is needed to improve the intervention?

Why would you prefer technological interventions or non-digital ones?

- For digital interventions → Which design elements do you recognise here?
    - It could be related to the task itself, how that is displayed (primary task support)
    - It could be about what the interactive system entails in the app (dialogue support)
    - Or it could be about the credibility of the app (system credibility support)
    - If it is hard for the participant to describe a design element, then provide an example of a design element from the PSD model.

"Opinions/experiences of technology" (ask it if they choose technology)

How proficient are you at using technology? Phone, computer? How much do you use them?

- What is useful from technology? What is too much?

If you prefer technological interventions, what preference in media would you have? (Video, website, games, apps?)

Combine feasibility with sof the parent

Do you feel that an intervention preventing oral caries would improve/worsen your stress level? Why?

- conforming to societal norms?
- Extra effort?
- Good support?
- Etc.

Wrap up

Any questions?

Thank you for participating

Refer back to informed consent and anonymity

If any more questions about study: contact information

Appendix B

Information Sheet and Informed Consent Form

Information letter Interview Study "Exploring Parental Needs in Interventions for Preventing Tooth Caries in Children between 0-5 years"

Welcome to this interview, thank you for volunteering. I am currently gathering data on the needs and preferences of parents regarding interventions to prevent childhood tooth caries. Interventions are actions taken to prevent tooth caries by helping participants carry out an action plan like suggesting better dental care.

I am specifically interested in what needs and experiences parents of young children have in interventions to prevent their young children from developing tooth caries and would like to know about your thoughts on examples of such interventions. The interview will take about 45 minutes to complete. All your data will be anonymous.

Naturally, participation in this research is voluntary. You can decline to participate and **withdraw from the research at any time**, without any negative consequences, and without providing any reasons.

The interviews will be audio recorded. The interview data will be fully anonymised upon transcription, and all interviewees will be referred to by pseudonyms throughout the analysis and in the final written works produced from the data. Individual participants cannot be identified from the assignments written using this data.

The BMS ethical committee / Domain Humanities & Social Sciences at the University of Twente has approved this study (application number 240357). The data will be stored safely according to the data policy of the University of Twente until 10 years after the research has ended.

The student conducting the research is Rosalia Mardjo (r.mardjo@student.utwente.nl) and the supervisor is Lea Hohendorf, MSc (l.hohendorf@utwente.nl).

Consent Form for "Exploring Parental Needs in Interventions for Preventing Tooth Caries in Children"

YOU WILL BE GIVEN A COPY OF THIS INFORMED CONSENT FORM

Please tick the appropriate boxes	**Yes**	**No**
Taking part in the study		
I have read and understood the study information dated 08-04-2024, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	□	□
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	□	□
I understand that taking part in the study involves taking part in an interview where the audio will be recorded and later transcribed into text. The audio recordings will be deleted after transcribing the interview. The transcription will be stored for 10 years.	□	□
Use of the information in the study		
I understand that information I provide will be used for our own research reports and future research, including possible publications of the results from this study.	□	□
I understand that personal information collected about me that can identify me, such as [e.g. my name or where I live], will not be shared beyond the study team.	□	□
I agree that my information can be quoted in research outputs	□	□
I agree to be audio recorded.	□	□
Future use and reuse of the information by others		

I give permission for the anonymised transcript that I provide to be archived in [*name of data repository*] so it can be used for future research and learning. The results will not be used for commercial use.	□	□
I agree that my information may be shared with other researchers for future research studies that may be similar to this study. The information shared with other researchers will not include any information that can directly identify me. Researchers will not contact me for additional permission to use this information.	□	□

Signatures

_____	_____	_____
Name of participant	Signature	Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____	_____	_____
Researcher name [printed]	Signature	Date

Study contact details for further information: [*Name, email address*]

Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee/domain Humanities & Social Sciences of the Faculty of Behavioural, Management and Social Sciences at the University of Twente by ethicscommittee-hss@utwente.nl