Exploring the Compliance of Resilient High-Caries-Risk Patients Who Reversed Caries Severity

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Abstract

Background: Behavioural factors, such as compliance and regular dental attendance, have been proven to reverse caries severity. However, these factors have not been explored enough. The aim of this study was to explore the behavioural characteristics of compliant patients who had severe dental caries in primary dentition but whose dental conditions were considerably improved in mixed or permanent dentition.

Methods: The 'w and W' criteria were designed to classify patients who had a worse or higher caries risk in primary and mixed or permanent dentition. Resilience, or reversal of caries severity, was thus defined as improvement based on these criteria. Interviews were performed with two groups of participants, including eight resilient children (M/F= 5/3) and their ten caregivers (M/F=2/8) in the patient group and ten paediatric dentists (M/F=6/4; clinical experience mean=26.9 years, minimum=16 years) in the dentist group. Thematic analyses were used to identify main themes.

Results: Four themes were identified: (1) dental things/teeth are their priority, (2) normalising, (3) tiger parenting/conscientiousness and (4) trust. These ideas were identically described by both the patient and dentist groups.

Conclusions: Resilience is the behavioural characteristic of children who outperform expectations, given their caries history and risk. Resilient patients reverse the fate of their teeth by their compliance with treatment protocols following dental guidelines, changing their dental behaviours, and thus, leading to treatment success. Dentists' suggestions are the priority and provide the norms in resilient patients' daily life. These patients find no excuses for not implementing dentists' advice, not only because they trust their dentists but also because they and their caregivers were conscientious about following dentists’ orders.

Background

Risk-based caries management is an evidenced-based approach to prevent and manage caries. There are various forms of risk-based caries management, but they share similar caries risk factors. Harmful bacteria, low levels of saliva, intraoral infectious conditions and caries experiences are the most-mentioned risks [1, 2]. However, as social and behavioural factors also contribute greatly to oral health, the influence of behavioural factors has been underestimated in previous models [3].

Initial caries risk can predict future caries conditions [4]. Children who have severe early childhood caries are prone to have new caries [5]. Caries risk remains the same as children age [6]. Thus, severe early childhood caries (SECC) is not only a serious childhood problem but may also increase caries severity in adulthood [7]. SECC may cause pain and infection in young children, leading to the need for multiple complicated treatments and difficulties cooperating during regular dental treatments. Comprehensive and extensive dental treatments for these children with ECC may need to be achieved under dental general anaesthesia (DGA, GA); however, they have new caries soon after DGA [8, 9]. The caries recurrence rate after DGA was 37 - 54% in 6 months [9, 10]. The relapse rate is not relevant to caries severity before treatments [11], caries prevalence, the level of bacteria [12], or the surface at risk after DGA [10]. Thus, factors that do not belong to infectious conditions might determine the potential for caries relapse. Since behavioural factors, such as parental beliefs and behaviours, have been proven to influence caries relapse after DGA [8, 13], it is necessary to identify behaviours that are essential for the prevention of caries relapse, especially in patients with severe caries conditions.

Compliance is a crucial factor in achieving effective and successful treatment results. It could be defined by patients' behaviours, such as better adherence to doctors' suggestions, attending follow-up appointments, engaging in

preventive care, and following recommended medical regimens. Inability to comply is regarded to increase the patient's caries risk level [1]. Noncompliant subjects, defined by non-follow-up or irregular follow-up, could be the strongest predictive factor of recurrent caries and repeated DGA [10, 11, 14]. Because strict adherence to the post-DGA preventive plan is a part of the concept of compliance [11], compliance is the potential key to successful outcomes, i.e., real caries control, and should be deemed an important protective factor. Nevertheless, in risk-based caries management, compliance has been under and unclearly addressed in the literature.

In addition, according to protocols of risk assessment, a single white spot lesion warrants classifying a patient as having a high caries risk. However, no classification tool has been designed to differentiate patients who have one from those with multiple caries lesions [1, 2]. The extreme risk was correlated only with reduced salivary function [2]. The recurrence of caries is also not clearly defined among of the various caries risk assessment measures [1, 2]. Thus, to monitor their treatment outcomes, a tool to differentiate the levels of caries severity and improvement among high-caries-risk patients is needed, especially during mixed dentition when the timing of tooth eruption and the progression of caries are hard to measure.

The paper of Amin et al. has addressed the parents of children who have caries relapse at 6-month recall were less receptive to advice from dentists [13]. Therefore, there is a need to understand compliance in the non-caries-recurrent group of SECC children who reverse their caries severity in longer term, with behaviour models. The aim of this paper is to explore the potential compliant behaviours that reverse caries severity from both patients' and doctors' perspectives.

Methods

Recruitment of participants

Two types of purposive samples were recruited. High-caries-risk patients who reverse their caries severity and their parents were invited to discuss compliance or adherence from the patient's point of view. All of them were treated by the same dentist, MCW. Experienced paediatric dentists who had practised for more than 16 years were also recruited to discuss compliance or adherence among their high-caries-risk patients who reversed their caries severity from the clinician's point of view. Data analyses and collection were concurrent. Recruitment ceased after no additional information was generated and data saturation was reached. Ethical approval was obtained from the Ethical Board (2019-09-010C). Informed consent was obtained for all participants.

Worse conditions in the high-caries-risk patients

The caries severity or number of cavities in high-caries-risk patients varies greatly, but improvement of caries severity within this group cannot be revealed clearly using the ICCMS™ or CAMBRA, since a patient is classified as having a high caries risk when any of the high-caries-risk factors is present or any previous restoration has occurred in recent years [1, 2, 5]. Experiencing caries in childhood usually predicts the condition in adulthood [7]. The early loss of primary teeth and premature eruption of permanent teeth may not indicate a reduction in caries conditions. However, no tool is available to compare changes in caries severity occurring from the primary to the mixed/permanent dentitions. Therefore, the w and W criteria, describing the worse conditions of high-caries-risk patients for primary and mixed/permanent dentitions separately in Tables 1 and 2, were piloted with experienced paediatric dentists and an oral pathologist. The rationale for this classification was adopted from several previous publications. This classification defined the severity of these worse conditions based on dental caries patterns, which were determined

by tooth location and the timing of eruption. Patients' caries risks were worse when both anterior and posterior proximal teeth were affected [15, 16]. The caries risk needed to be adjusted with the eruption time [15]. The severity measure of early childhood caries was adapted from previous papers [17-19]. Caries patterns and anatomical sites were also used as potential clinical caries risk factors [20-22].

Resilient high-caries-risk patients whose caries severity was reversed

There is a lack of criteria to define the differences between high-caries-risk patients whose caries severity improves or not from a long-term perspective. In this study, 'resilient' high-caries-risk patients were those whose 'W' criteria were improved in mixed/permanent dentition compared to their 'w' criteria in primary dentition. 'Refractory' high caries risk patients were defined as those whose W criteria remained or worsened over time, and these patients were excluded from this study even though they complied with dentists' suggestions and regular follow-ups. Among the resilient high-caries-risk patients, compliant individuals were included in this study, as determined by the following dental behaviours:

1. Parents and children were never lost to follow-up and were followed up for at least six years.
2. Parents and children showed active or positive attitudes towards complying with dentists and treatment plans.

Since compliance with treatment protocols is different from cooperative dental behaviours [23], children who were not cooperative with pulp or extraction treatments and who had dental anxiety according to his/her or parents or the dentist's observation were not excluded.

Tool development

A topic guide for this semi-structured qualitative interview was developed based on a literature review [6, 8]. Open questions were designed with the theoretical domain framework (TDF) to comprehensively cover potential compliant or resilient behaviour and moderated by a paediatric dentist with qualitative research training (MCW). Using the TDF, which is derived from 33 psychological theories, can prevent the omission of potential behavioural factors [24]. The order in the TDF was not strictly followed to allow the participants to respond flexibly. The topic guide was piloted with other children to ensure that the questions were clear and understandable for this age group.

Data collection

Interviews, as a qualitative study design, were used to explore the compliant behaviours in resilient high-caries-risk patients. Since there is little understanding of compliant behaviour, a qualitative study design is more suitable to probe the details at the stage and give the participants freedom to express themselves thoroughly [25].

Data analysis

All interview transcripts were analysed using thematic analysis [26]. Analyses were undertaken with Microsoft Word. The coding was performed by the first author (MCW) and confirmed by the third researcher (WHC). The themes were derived from the data, and the synthesis of the thematic map was achieved by three authors (MCW, CYW and WHC)

to reduce interpreter bias from the first author (MCW) [25]. Considering the possible bias introduced during analyses by the researchers themselves, member-checking was undertaken during each session to confirm the interpretative validity [25].

Results

Overview of the participants

Two groups of participants were invited to participate in this study. There were eight children (M/F= 5/3) and ten caregivers (M/F=2/8) in the patient group. All these patients, demographic data of which are shown in Table 3, received comprehensive dental restorative treatments in multiple outpatient department (OPD) appointments, and one of the patients received another surgical removal of mesiodens under general anaesthesia. There were ten dentists (M/F=6/4; clinical experience means=26.9 years, minimum=16 years) in the dentist group. Seven of the dentists received their degrees from other countries. Seven dentists worked in both medical centres and private practice. Two dentists practised only in medical centres, and one dentist practised only in private practice.

Overview of the results

The themes from the patients who reversed their caries risk were mainly related to patient aspects rather than dentist aspects and were especially related to parent aspects according to both dentist and patient participants. Most of our dentist participants stated that the resilience of caries conditions depends on patient factors because dentists treated all their patients in the same way, but only a small proportion of patients were able to reverse their caries risk or condition. Most of the dentists could clearly describe similar ideas and characteristics among the resilient patients, which were similar to the features of the included patient participants.

[Doctor #8] I feel tiger moms who prefer to take control are more prone to be successful, but this is because these parents would keep on bringing their children back. They are not necessarily tiger moms. They care about dental things more. … I feel the ratio between dentists and parents is 3 to 7. Thirty percent relies on dentists, and 70% relies on parents. … It is the parents who must accomplish things. They may not be control freaks. They may be determined. … Dentists provide solutions, but not all parents adopt the solutions.

[Doctor #7] Moms knew the 'Achilles' tendon' of their children. Their children's Achilles tendon was attacked, and then the children became compliant. … We originally thought dentists, parents, and children are a triangle, but it can be a linear relationship… Don't put the responsibility of controlling children on dentists…. You (dentists) need to persuade the parents to be willing to control their children.

[Doctor #9] The resilient patients who improve have parents who accept things very quickly…. When dentists tell them what to do, they (parents) just accept, and their habits change with your suggestions. Hence, the habit will be maintained after treatments, which means that these patients need only the first-round treatment. The refractory group has parents who have difficulties influencing their children. Children have caries in mixed dentition, and these children are not resilient.

In the analysis, four essential themes were identified from the similar descriptions provided by dentist and patient participants: dental things/teeth as their priority, normalising, tiger parenting/conscientiousness, and trust. The subthemes and illustrative quotes in these four main themes are outlined in Table 4.

Main theme 1: dental things/teeth are their priority

All the participants in both the dentist and patient groups thought that compliant patients who reversed their caries risk considered teeth to be the first priority. Compliant parents valued or appreciated the importance of dental health and the severity of the dental conditions of their children. They always remembered to visit their dentist regularly and were willing to take a day off to take their children to a dental appointment. Parents might obtain this attitude from their own experience, but they perhaps did not make their own teeth a priority.

[Researcher] …Is it inconvenient to keep asking for days off for dental treatments?

[Casper's female caretaker] Nope, I feel (dental) health is more important than work. I must do what needs to be done.

[Cindy's female caretaker] In addition, because my teeth are not well, I think teeth are very important.

These parents valued dental treatment rather than their children's dental experiences. Although their children cried or fought during treatment procedures, behaviour management techniques or mild physical restraints were acceptable for them. None of our patient participants received restorative treatments under general anaesthesia or sedation. They understood that successful treatment outcomes might not come in an easy way.

[Conan's female caretaker] Crying and fighting severely on the dental chair are normal responses of children. When they mentioned general anaethesia, I denied and wanted to have it step by step.

[Researcher] So you didn't want to have general anaethesia?

[Conan's female caretaker] No. I wanted him to get used to it.

[Researcher] Is it inconvenient or difficult to come so many times?

[Conan's female caretaker] It's OK. We must be cooperative.

[Doctor #8] The chance for retreats is higher for TCI (a kind of sedation) children. … If the patient disappears, it is because of the attitude of parents. Usually, when they come back, you will notice that it (caries severity) is the same for several years. Therefore, this is because of the attitude of parents. The second thing is how seriously do they think about using fluoride. … Patients of TCI, honestly, are just the same of the study of GA. The record of the GA study shows a higher recurrent caries rate. If you do not perform behaviour management, after the treatment of TCI patients, they are still afraid of visiting dentists. After TCI, you can't train them for a while. Parents of these (refractory) patients hope that their children can visit dentists happily. When they know that you finish TCI, they will not let you touch their kids. In your mind, you will have a long window period. You cannot do complete treatment.

Parents with a higher socioeconomic status had more resources to take better care of their children's teeth. Nevertheless, it was the parents who were responsible for these children reversing their caries conditions, who recognised the importance of their children's dental health, and who were compliant with dentists making their children's teeth better.

[Doctor #6] I don't think socioeconomic status is the absolute factor. How do parents value it (dental health) is more important. Very rich parents do not necessarily value it. An average family (with parents as office workers) might value it. However, among parents with high socioeconomic status, the ratio of this kind of people seems to be higher.

[Celine's female caretaker] I am the kind of person who gets a good thing and then promotes it. My friends (refractory parents) did not keep (visiting the dentist). I don't know what they were doing. They live truly close in an expensive area in the Capital and 10 minutes away from the dental clinic. … and these two moms did not need to work.

Main theme 2: normalising

It was normal or routine for all these compliant patients and parents to practise oral health behaviours, such as brushing teeth or dental visits. They, especially children, might not engage in health behaviours for any specific reason or motivation, such as making themselves healthier. They might maintain oral health behaviours because they got used to keep on doing it or do it subconsciously. They might also feel weird not doing it. Those oral hygiene behaviours became their habits might be the reason that their oral health was maintained, and the effect could be long term.

[Cindy's female caretaker] I just tell her that you take good care of your teeth. It is for her own good, not for me.

[Cindy] … Because I have got used to keeping on coming back, it is a part of my routines. I don't think anything special about the dental visit.

[Che's female caretaker] Do you brush your teeth more seriously before you go to bed, Che?

[Che] I don't know. I would just brush my teeth.

[Researcher] What do you mean by 'OK'? Do you take a bath or exercise because you benefit from them? Or, do you worry that if you don't do these things, something bad will happen? Or, you simply think that you should listen to me or your mom.

[Conan] I just want to follow you.

[Conan's female caretaker] You should be afraid of being blamed? I do snap checks.

[Researcher] Therefore, you don't think that my teeth will become better because I do these?

[Conan] No.

[Researcher] You totally worry that you don't meet our requirement from both of us. Does health education in the school teach you how to take care of your teeth?

[Conan's female caretaker] Yes. They also distribute mouthwash and teach kids how to use it.

[Researcher] Does this make you want to take care of your teeth?

[Conan] No

[Researcher] Do you worry that your teeth will be rotten if you don't follow the rules?

[Conan] No.

[Researcher] Don't you think your teeth will be broken?

[Conan] No, I don't think so.

[Researcher] You know that, if you don't take care of your teeth, they will be ruined. Don't you think this occurs to you? Or, you think that's something far away in the future?

[Conan] Too far away in the future.

Main theme 3: tiger parenting/conscientious

Many parents were tiger parents. They were determined, not caring whether their children could receive treatment cooperatively or calmy. They decided that their children should go through the treatments and followed the dentists' suggestions. They remembered to come back regularly. They remembered the details of the dentists' suggestions and their children's daily dental behaviours. Hence, they can confirm these with their dentists in latter appointments to ensure they have achieved dentists' suggestions. Nevertheless, these parents and their children might not have a clear goal. They just followed the dentists' orders.

[Celine's female caretaker] Only a tiger mom can make a child of this age follow the rules. Otherwise, when you tell her thoroughly, she will not understand.

[Researcher] … What's the difference? … Because you believe that she has the ability to achieve it, and you trust her that she can do it when you ask, so you do this. Or, you don't think about it. You just set the rules and she has to make it. …

[Celine's male caretaker] Because you dentists make the rules, I think that I should cooperate. … In addition, she likes you. She did not resist you at all. The first or second appointment did not count because you were strangers. She is OK afterwards.

[Dentist #5] (Resilient) parents always come back. They must know how to take care of their children. They always know what happens to their children. They even ask me whether they should change to electric toothbrushes. Parents use all kinds of means to change their children's behaviours and to make this (dental thing) work. These parents return every three months, sharing their experience and feedback with the dentists. So, I know that they are serious.

Most parents liked to achieve something or be praised by their dentists, feeling guilty or bad when they knew that they had not yet done enough. They would find ways to manage their children to follow the dentists' orders. Nevertheless, they might not want to be the best or flawless. They just did not like failing.

[Cole's male caretaker] … (About their experience in previous dental clinics) After the examination, the dentist condemned us (parents). He said that these were parents' fault. … I felt sorry for my child. I wanted to find solutions when I was blamed. … After I was condemned then, I felt sad for a long time. I felt that I ignored these things and then made his teeth like this. Many people said, 'It's OK. It's just caries'. However, I felt depressed, and how come we didn't notice this.

Main theme 4: trust

Most parents mentioned that they trusted or respected dentists. Thus, instead of following what was shared by their friends or websites, they would believe what was instructed by dentists. Some of the parents even stated that it was fate to meet the dentist.

[Chas's female caretaker] Someone suggested you (the dentist). Serendipity. I quite believe in fate. If it felt right, I had confidence in the dentist. Then, the trust would be there.

[Celine's female caretaker] I am not that keen on (googling the information). However, I absolutely believe in the profession. Yes, I trust in the dentist's profession, and my kid likes the dentist. I can arrange and come to the dental appointment, (so) why not?

[Casper's female caretaker] Yes, the previous dentist (in your clinic) was very patient, so I felt quite good. Then, I met you (dentist). I thought you trustworthy, and we just followed you step by step.

These parents also had trust in their children, and they believed their children could succeed. These parents usually had good relationships with their children and did not force them to do things. Therefore, they can cooperate well with their children and then follow dentists' instructions together.

[Doctor #9] Yes, resilient parents trust both their dentists and children. As long as we do this, everybody will get better together, and things will get better. … I did not feel these parents force their children. I felt the resilient children usually had a good family relationship. …The mom and child both felt these dental things were what should be done together. The mom got a new concept, and the child accepted and did what was asked. The resilient parents did not force their children. Then, they happily came every three months for fluoride varnish. I feel this is the characteristic of resilience. … Parents who need to force their children, their caries severity did not improve.

Discussion

No single intervention has been strongly shown to control caries effectively, and a combination of caries preventive methods should be tailored to meet individual needs. Compliance is perhaps what makes the treatments able to be implemented and result in effective outcomes [27]. Compliant behaviours, such as regular follow-up, make people who have severe caries histories experience fewer new incipient caries [11, 14]. However, compliance is a set of complicated behaviours that have not been defined clearly in the caries literature. The beauty of this study was the analyses of compliance in resilient patients whose caries conditions were reversed in longer term. These resilient children with histories of high caries risks did have fewer new incipient caries than expected, according to clinical experience and the literature on caries risk assessment [2, 7, 28]. The characteristics of patients at low risk were another story and hence were not included in this study. The factors that reverse caries conditions are addressed in the following sections.

Priority given to dental care was what made these participants reverse their severe caries conditions in the long term. A previous study reported that parents' attitude towards oral health practices and a lack of knowledge might not influence recurrent caries conditions. Patients usually know that teeth and oral health are important, but this does not imply that they implement what is suggested by dentists every day. Parents even doubted the possibility of 'keeping teeth cavity-free' after GA in another study [8]. This implies that knowledge of oral health alone was not enough to change oral health and behaviour. Furthermore, non-resilient (relpase) parents did not receive the advice from dentists, and they had lower self-efficacy for controlling their child’s oral healthere [13]. In contrast, our resilient participants perceived teeth to be more important than other important things. As a result, even against or ignoring children's original willingness, resilient parents eliminated barriers to complying with the dentists' orders, such as receiving dental treatments, regular follow-ups and toothbrushing.

Normalising was also an essential factor that made these patients reverse their caries conditions in our finding. This is more than believing no caries is normal in life [13]. Normalising has not been previously addressed in the dental

literature. However, according to our participants, these patients and their parents were not resistant to dentists' suggestions even if the suggestions were new or not easy to implement at first. These parents and their children did not take dentists' suggestions as the knowledge in textbooks. Oral health education from their dentists was not similar to compulsory education. In contrast, these participants obtained the information more like they absorbed the diffusion of norms in life, and the dentists' suggestions became new routines in their life. Therefore, they could follow the behaviour as a habit and kept it for a longer term, and the participants in our study were followed up for more than six years, which was much longer than in previous studies [9–12]. Furthermore, it is difficult to probe these norms with traditional questionnaires, which may be mixed up with a pure knowledge style. In contrast, we used the semi-structure interview to explore the collective behaviour changes after receiving instructions from their dentists. The advantage of the interview design is that it reveals the real belief or practice in the participants' lives, and interviews do not restrict participants' ideas with researcher-designed questionnaires [13]. Interventions designed based on participants' ideas may bring better behaviour changes in the real world. Therefore, using norm-based interventions to change patients' risky behaviours in caries management may have been underestimated and worth further exploration.

The tiger parenting identified in our study was different from the original, harsh stereotype of a tiger mom from Chua's book [29]. Instead, tiger parents were conscientious, not that authoritarian, but not permissive. Non-resilient (relpase) parents were usually permissive [13]. Tiger parents tended to achieve their goals. These parents did not fail dentists, thus making their children follow or implement the dentists' guidelines. Low conscientiousness may also be a risk factor for periodontal treatments [30]. Nevertheless, for periodontal treatments, a patient and a dentist have a direct relationship. In contrast, for paediatric treatments, a tiger parent is more like a moderator between the dentist and the child. Furthermore, differences in protocols of periodontal and paediatric treatments might also make conscientiousness play different roles. This is worth further studying the underlying mechanisms from social network and social support perspectives.

Trust might be the most obvious factor in patient compliance. However, that patients who had good relationships with dentists and had regular follow-up did not guarantee reverses of caries severity in the longer term. These trusting non-resilient patients or parents might have other priorities in their lives. The non-resilient (relpase) parents who were willing to comply might not be able to make their children follow them and their dentists compared to resilient (no relpase) parents. They may have been concerned that forcing their children to dental clinics or brushing may harm their relationship with their children, which is more important than their children's teeth [13]. Therefore, these parents would rather see their children's teeth rotten, though they understand the consequences of caries and have personal trust relationships with dentists. Hence, to make these trusting participants succeed in reversing their children's caries severity, other compliant factors discussed previously, i.e., priority, normalising and conscientiousness, should also be involved. Because there is no good or consistent classification or measurement for secondary or new incipient caries conditions in mixed dentition [27], compliance and resilience should be explored and defined clearly with qualitative studies first and then can be verified with further quantitative methods.

Resilience from both our dentists' and patient participants' perspectives mainly resulted from the patients' own behavioural factors and characteristics. Our dentist participants expressed that the key was the patients and parents themselves rather than dentists. The patient participants mentioned they were lucky to meet their dentists, but they talked more about their own factors. Thus, dentists may play a role as social support from the community [28]. This finding echoes previous papers, which reported that the compliance or attitude of patients, rather than treatment choices or caries severity, affected the treatment outcomes [10–12]. Papers have seldom addressed treatment choices, perhaps because treatments are decided according to guidelines. However, not every dentist complies with

or follows guidelines. The difference in prognosis between dentists who do or do not follow guidelines or other factors could be explored in the future.

The broad implication of the present research is that the improvement of caries severity has rarely been addressed in the literature. Even one caries lesion defines a patient as a high-caries-risk one. However, there is no classification to differentiate patients with more lesions or higher caries risks. Among these patients with high caries risks, improvement of their caries conditions was not found based on previous caries risk assessment tools. Hence, the w and W criteria advocated in this paper may help clinical dentists identify resilient patients who do not fully recover but do improve their caries conditions. On the other hand, refractory patients who may worsen their high caries risks may need to be explored in future studies.

Conclusion

The behavioural aspects have been under-addressed in caries management literature. The prognosis of severe dental caries in children may not be totally determined by the original caries severity, bacteria, and interventions. Thus, compliance with treatment protocols, which is likely a key to reversing caries severity, was analysed in resilient participants defined by newly designed w and W criteria. Compliance does not merely rely on trust but, more likely, on the priorities of these patients and their parents. Implementing dental plans as their norms in life, perhaps with the spirit of tiger parenting or conscientiousness, also leads to better long-term outcomes. Thus, including a protocol to build resilience in caries management deserves an emphasis in clinical practice.

Declarations

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Authors' contributions

Ming-Ching Wang: Conceptualization, Methodology, Verification, Formal analysis, Investigation, Resources, Writing-Original Draft, Visualization, Project administration. Ching-Yi Wu: Verification, Writing- Original Draft. Wei-Han Chen: Formal analysis, Investigation. Chieh-Yu Liu: Conceptualization, Methodology, Verification. Yi-Ching Ho: 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 (2019-09-010C). 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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Tables

Table 1. Worse conditions of high-caries-risk patients in primary dentition: w criteria

Conditions	Clinical indicators
High caries risk (w)	multiple anterior caries, or dmfs ≥ 8, or 2 - 4 crowns
High caries risk (ww)	multiple posterior caries, or dmfs 12 - 24, or 4 - 8 crowns
High caries risk (www)	multiple anterior + posterior caries, or dmfs > 24, or crowns > 8

Note:

1. Trauma is excluded in the dmfs.
2. Early extraction due to caries is counted in the dmfs.
3. Enamel hypomineralization or hypoplasia is counted in the dmfs.
4. Possibly level up if the tooth surface show activeness, loss of luster or roughness.
5. Possibly level up if plaque or roughness is noted on restorations.
6. Possibly level up if signs of decalcification or caries are shown soon after eruption.

dmfs=decayed, missing, filling, surface

Table 2. Worse conditions of high-caries-risk patients in mixed or permanent dentition: W criteria

Conditions	Clinical indicators
High caries risk (W)	recurrent pit caries of 6s, or DMFS>=8, or enamel hypoplasia or MIH
High caries risk (WW)	proximal caries of 6s, or anterior teeth decalcification, or DMFS 12 - 16, or fracture of enamel hypoplasia or MIH
High caries risk (WWW)	anterior proximal caries, or caries or enamel hypoplasia of premolar, or DMFS > 16, or any pulp involvement or crown of any permanent teeth

Note:

- l Exclude trauma, dens invaginatus, or dens evaginatus oriented restorations.
- l Possibly level up if criteria are noted before 7s eruption.
- l Possibly level up if the tooth surface show activeness, loss of luster or roughness.
- Possibly level up if plaque or roughness is noted on restorations.
- l Possibly level up if restorations with initial signs of secondary caries, such as discolouration, or prone to loss

DMFS= decayed, missing, filling, surface

MIH= molar incisor hypomineralisation

Table 3. Demographic data of all subjects

Pseudonym	dmfs+DMFS (age)	Decayed teeth	w criteria	DMFS (age)	Decayed teeth	W criteria	Frankl scale [23]	F/U
Celine	14 (2.4 y.o.)	ABs	w	8 (10.8 y.o.)	X (fissure sealants)	-	– è ++	8.3 yrs
Cole	15 (1.7 y.o.)	ABs	w	8 (11.5 y.o.)	6s (Not recurrent)	-	- è +	9.8 yrs
Che	20 (3.1 y.o.)	ABs	w	8 (13.7 y.o.)	6s (Not recurrent)	-	- è ++	10.6yrs
Chas	51+8 (7.5 y.o.)	Cs DEs, 6s	www	8 (15.4 y.o.)	6s (Not recurrent)	-	+ è +	7.9 yrs
Cindy	32+8 (8.5 y.o.)	DEs, 6s	www	8 (14.9 y.o.)	6s (Not recurrent)	-	++ è ++	6.4 yrs
Clare	30 (2.7 y.o.)	ABs, DEs	www	8 (11.4 y.o.)	6s (Recurrent)	W	– è –	8.8 yrs
Conan	38 (3.5 y.o.)	ABs, Cs DEs	www	8 (12.1 y.o.)	6s (Recurrent)	W	– è –	8.6 yrs
Casper	61 (4.0 y.o.)	ABs, Cs DEs	www	10 (15.0 y.o.)	6s (Recurrent) 12s (decalcification)	WW	– è -	10.1 yrs
							Average F/U yrs	8.9 yrs

dmfs, DMFS= decayed, missing, filling, surface

y.o.= years old

F/U= follow-up

yrs.: years

Table 4. Themes derived from the categories

Potential discussion point (subthemes)	Quotes
Theme 1: Dental things/Teeth are their priority	
Parents aware of the importance of teeth from their experience.	*[Researcher] You think teeth are important. For what reason?* *[Clare's male caretaker] Because my teeth are not good.* *[Researcher] Thus, not because of the public media. Now, everybody always propagates tooth whitening and aesthetics.* *[Clare's female caretaker] Tooth whitening is not that important. She should not have cavities and be normal. I don't think she should have tooth whitening.*
Parents aware of the dental severity of children.	*[Doctor #10] But, I feel parents cannot catch (the warning from dentists), unless he has suffered what I (dentist) have warned. For example, children who have suffered from a toothache in the middle of the night or children whose face as swelling or who have experienced cellulitis. … Parents can shock them by telling them that this thing can influence permanent teeth, so this may influence their behaviours. … Parents cannot understand until they see or witness it.*
Parents are willing to manage their time to visit the dentist. Nevertheless, parents may not treat their own teeth this way.	*[Cole' male caregiver] Is it just the way, it is? We should come back when we have an appointment. That's the case. We make a day off when we are not available for his dental appointment. I think that is for sure. You should come back when dentists arrange visits, shouldn't you?* *[Cole' female caregiver] But, you may miss your own dental appointment.*
Parents do not care about their children's uncooperative behaviour or crying in the dental clinic because they want to make their teeth better.	*[Researcher] So, were you so frightened after you saw her cry (during a dental treatment), that you would not come back?* *[Clare's female caretaker] It is much better than all her teeth rotting.* *[Clare's male caretaker] I care of only her teeth and eyes. Only these two things. Other things are irrelevant.*
Theme 2: Normalising	
Brushing is a daily habit.	*[Casper's female caretaker] … After he brushes his teeth by himself, he reminds me. He doesn't forget to brush his teeth. He brushes his teeth almost every time. Unlike us, we forget to brush when we are too tired. He has the habit already.*
Dental visit is a regular habit or routine. They do not even think about it, and they just do it.	*[Chas] It is maintained as it used to be. … After a while, it is like a habit.* *[Researcher] But, you don't think about it? Or, you think a lot?* *[Chas] I don't think further.*
Parents do not see dental caries as a	*[Cindy's female caretaker] Nope, I like this way (treatment at the early stage) because, take her elder sister as an example, she got cavities over her anterior incisors. … The dentist (in the local clinic) felt it was normal that children have cavities. There is no need to be nervous or paranoid about cavities if the child is not in pain or experiencing swelling. …. I did not like these ideas*

normal condition.	*(from previous dentist). So, I searched for a dentist like you who prevents cavities from very early. I do not want to treat caries after they become severe.*
Theme 3: Conscientiousness/tiger parenting	
Authoritative parents or tiger parents who are determined can make children follow orders.	*[Dentist #8] I think it (resilience) is tiger moms who like to control things. It brings success easier. Those who bring their children for follow-up appointment persistently are not necessarily tiger moms. They should care about these (dental things). Tiger moms tend to succeed. They might be rigid. … While some parents are harsh, they merely tell their children to do things in a harsh way, … Those parents shout out at their children, and then they turn their head to cook. They do not always succeed, do they? ... But, some parents talk to their children seriously, and they keep on persuading their children. They have a higher success rate, don't they? … The parents who want to achieve things but who may not be control freaks. They could be just determined.*
Parents usually implement their work carefully.	*[Dentist #5] (Resilient parents) can't lose. From the clinical aspects, sometimes, some parents help their children brushing their teeth diligently, but their children still have caries. Although their children's caries is not very severe, the parents still feel devastated. So, I said, these parents want to be the No. 1. They think they get some knowledge of this world (dentistry), and they work hard to implement the knowledge. But if the results are not as expected, then resilient parents cannot accept it. Thus, this kind of parents wants to know 'why' when they discuss with dentists. After dentists analyse the factors for their children's caries, these parents can implement (a treatment plan).*
Parents remember their dental schedule and details of treatment plans	*[Dentist #5] I think this group tends to remember the appointment time or the given treatment plan easily. These parents care about details, and they remember details. There is another kind of parent who you (dentist) must remind several times and, if you ask them every time, they (refractory parents) remember nothing. I think these things occur less in this (resilient) group.*
Parents like to be praised.	*[Dentist #5] Most successful parents usually do not care how the child feels. These parents' goal is that the dentist gives them 100 points (A++).* *[Researcher] Some of my resilient children cried a lot in the dental chair, but their parents just kept coming back for follow-up.* *[Dentist #5] Therefore, the first thing is that the severity of caries made the parents take the dental thing seriously. The second thing is that these parents wanted to get 100 points, but their children did not want to get 100 points.*
Parents do not like to fail or miss things and do not like doctors to say bad things about them.	*[Cole' male caretaker] The feel is that after being condemned by the previous dentist. My depression lasted for a very very long time. The feeling here was that my kid's posterior teeth were not that bad. Then, we still had a chance.*
Theme 4: Trust	
Caregivers and children trust dentists' expertise or authority.	*[Che] Is it normal to believe dentists? Instead of believing myself, I would rather believe a dentist.*
Caregivers and children respect dentists.	*[Dentist #9] Parents would respect dentists, trust dentists and have no negative feeling when receiving dentists' advice.*
Dentists are recommended by others	*[Celine's female caretaker] My friend recommended me to your clinic. … Then, I met you. The right one, saviour.*

Caregivers recommend their dentists to others.	*[Celine's female caretaker] Many people ask me (which clinic is better), like other classmates' moms. I would just recommend your clinic.*
Believe the information from the dentist rather from the websites	*[Che's female caretaker] I googled information before I visit a dentist. After that, I followed the dentist's advice.*