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Development of the Tooth Protection Model as an Action for Caries-Free and Early Stunting Prevention

Lina Rismayani[1] Emma Kamelia [2] Anie Kristiani [3] Aulia Fatmayanti[4], Anjar Astuti[5]
[1,2,3] *Department of Dental Nursing, Poltekkes Kemenkes Tasikmalaya, Indonesia*
[4,5] *Department of Midwifery, Poltekkes Kemenkes Semarang, Indonesia*

Corresponding author: Lina Rismayani
Email: linarisma91@gmail.com

ABSTRACT

Rampant caries in toddlers or early childhood caries (ECC) can affect chewing and the ability to eat and drink. The prevalence of caries in the 3-4 year age group in Indonesia in 2018 was 81.5%. A recent World Health Organization (WHO) report stated that dental caries can affect children's growth. Balanced evidence shows that ECC is associated with stunting in children. Rampant caries in primary teeth hurt nutritional status, mediated by caries depth, chronic inflammation, and oral pain. A dental and oral health caries prevention program is needed to prevent stunting. This research aims to develop and test the feasibility of a Tooth Protection Model for Preventing Caries and Stunting in Early Childhood. The research method used is Research and Development/ (R&D), consisting of searching for potential problems, collecting data through literature review and FGD, Design Making, Validation of three preventive dentistry experts and three pediatric dentistry experts, Revision and User Feasibility Test for 30 toddler mother. Data analysis uses an Interclass Correlation Coefficient (ICC) with a two-way mixed type. The results of expert validation obtained an average score of 75 (decent category with revision), with good inter-rater reliability (ICC = 0.750). The results of user trials on 18 mothers of toddlers produced an average score of 90.67 (very feasible category without revision), with an ICC value of 0.860, meaning good reliability. The research conclusion shows that the Tooth Protection Model is worthy of implementation as a comprehensive approach to preventing caries and stunting in toddlers.
Keyword: Caries; Stunting; Toddlers; Tooth Protection Model

Introduction

Dental caries is defined as a dynamic disease that is biofilm-mediated, diet-modulated, multifactorial, non-infectious, and results in the loss of mineral minerals in the teeth [1]. Untreated dental caries cause pain in the teeth [2]. Pain due to caries in the first tooth is significantly higher compared to the permanent tooth [3].

The prevalence of dendritic dental caries worldwide from 1995 to 2019 was 46.2% [4]. The prevalence of caries in the age group of 3-4 years in Indonesia in 2018 was 81.5% [5]. One of the main bacteria found in dendritic tooth caries is Streptococcus mutans [6], [7], [8]. The infectivity window of Streptococcus mutans occurs at 19-31 months, with an average age of 26 months and the latest discovery was found as early as 16 months [9], [10].

Caries in toddlers or early childhood caries (ECC) can affect chewing and the ability to eat and drink [4], [11]. A recent World Health Organization (WHO) report stated that dental caries can affect children's growth [12]. Balanced evidence shows that ECC is associated with stunting in children aged 0-18 years in various countries [13].

Stunting globally affects 167 million children under five and is one of the most significant obstacles to human development [14]. Stunting has long-term effects on individuals and society,

including reduced cognitive and physical development, reduced productive capacity and poor health, and increased risk of degenerative diseases [14].

In 2020, 149.2 million children under the age of 5 were stunted globally, or 22% of all children under five [15]. Projections show that 127 million children under 5 years old will be stunted by 2025. Further investment and action are needed to achieve the World Health Assembly 2025 target of 100 million [15]. The United Nations (UN) Sustainable Development Goal is to end all forms of malnutrition by 2030 [16].

The prevalence of stunting in toddlers in Indonesia in 2021 is 24.4%, with the highest age distribution at the age of 36 to 47 months. The prevalence of West Java exceeds the national prevalence of 24.5%. Tasikmalaya City is ranked 6th out of 27 cities/regencies in West Java, with a prevalence of 28.9% [17]. Convergence to pursue the RPJMN target of 14.0% by 2024 is one of the strategic pillars of the program to accelerate stunting reduction in children under five [18], [19]. Caries prevention programs in dental and oral health are needed to prevent stunting [20]. Severe caries in the first teeth negatively affects nutritional status, mediated by caries, chronic inflammation, and mouth pain [21].

The purpose of the research is to develop a Tooth Protection Model for caries- free action and prevent stunting in toddlers (16-35 months). This research supports a caries-free RAN 2030 and stunting-free 2030 [19], [22].

Methods

This study aims to develop a Tooth Protection Model to prevent caries and stunting in toddlers. The method used is Research and Development (R&D), which consists of several systematic stages.

The initial stage begins with the identification of potential problems. Furthermore, comprehensive data collection was carried out. Researchers will conduct an in-depth theoretical study of caries, stunting, and caries prevention methods, as well as CPP-ACP and MI Varnish technology. The subsequent identification was a Focus Group Discussion (FGD) involving preventive and pediatric dentistry experts. The research team will design the product based on the data and information collected. This stage includes the creation of a model flowchart, the preparation of a storyboard, and the development of the Tooth Protection Model.

The next stage of research is design validation. This process involved three experts in preventive dentistry and three pediatric dentists to assess the scientific and practical aspects of the model. The next stage is design revision, and finally, user use trials to assess the feasibility and ease of use of the model for 18 mothers under five in the Toddler Class, Karsamenak Village, Kawalu Health Center Area.

This study uses the ICC (Intraclass et al.) test to assess the reliability between assessors (inter-rater reliability), using the specific type of ICC test, namely two-way mixed.

Results and Discussion

1. Potential and Problems

Needs Analysis

Based on observations and interviews conducted with parents of toddlers in the Toddler Class of Karsamenak Village, several problems related to dental and oral health were found. The average parent does not know how to maintain dental and oral health at home, does not understand the time and how to brush teeth properly and correctly, and does not know how to protect children's teeth from an early age. In addition, they also need to understand the types of dental and oral diseases often encountered in toddlers who tend to be too lazy to take their children to the dental clinic.

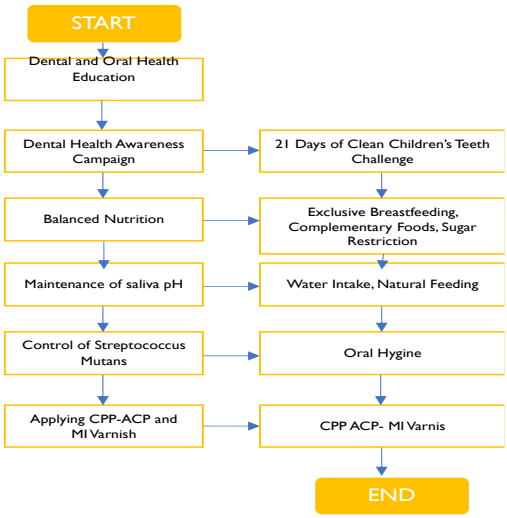
The prevalence of caries in toddlers in the Toddler Class of Karsamenak Village is relatively high, reaching 65.5%. Based on these observations, an innovation is needed, namely a Model Tooth Protection. This model is designed to help parents maintain the health of their toddlers' teeth and mouths and prevent stunting..

Material Analysis

Based on the data from the FGD and theoretical studies, it was found that there were categories of model content, including Education, Awareness, Nutrition, Saliva pH Control, Streptococcus Mutans Control, Casein Phosphopeptide- Amorphous Calcium Phosphate Administration (CPP-ACP) [23].

1. Design Stage
   a. Flowchart Model

Figure 1. Flowchart Tooth Protection Model



The Tooth Protection Model is a comprehensive approach to preventing dental caries and stunting in toddlers, where Figure 1 shows a flowchart design of its implementation consisting of six main components: dental and oral health education, awareness campaigns through the 21-Day Clean Child Teeth Challenge program, implementation of balanced nutrition with Exclusive Breastfeeding and Complementary Foods, maintenance of salivary pH, control of Streptococcus Mutans through oral hygiene, and application of CPP-ACP MI Varnish for additional protection. This model aims to build dental health and support optimal child growth by relying on active parental involvement and regular monitoring from healthcare providers.

   b. Storyboard

Figure 2. Storyboard Tooth Protection Model

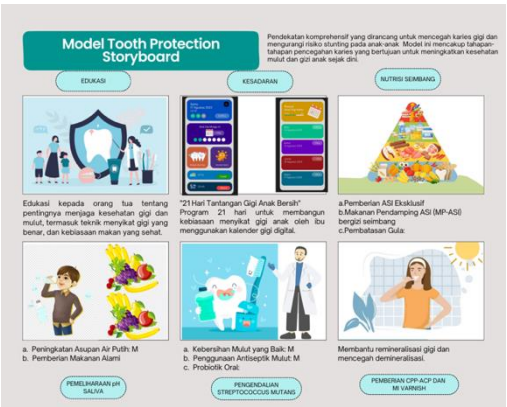


Figure 2 illustrates the Model Tooth Protection through a storyboard depicting three main intervention aspects: education, stimulation, and healthy nutrition. The education component showcases dental health counseling approaches involving families and healthcare providers. The stimulation aspect is represented through tooth cleaning activities and the Clean Child Teeth application for monitoring dental health habits. Meanwhile, the healthy nutrition aspect is depicted through a food pyramid emphasizing Exclusive Breastfeeding, Complementary Foods, and sugar restriction. This storyboard also illustrates the comprehensive approach in maintaining salivary pH, controlling Streptococcus Mutans, and applying CPP-ACP MI Varnish as an integrated dental protection strategy.

2. Design Validation

Expert validation was carried out by involving six experts from two relevant fields: pediatric dentistry and preventive dentistry. A balanced number of experts from both fields (3 people each) shows an effort to obtain a comprehensive assessment. The average assessment result of 75 indicates that the validated instrument or material is considered "worthy of revision". Experts generally assess that the instrument is usable but needs improvements or adjustments. The following expert validation results are outlined in the table below:

Table 1.
Tooth Protection Model Expert Validation Results

No	Expert	Score	Mean
1	Pediatric Dentist	75	75
2	Pediatric Dentist	82,5	
3	Pediatric Dentist	77,5	
4	Preventive dentistry expert	65	
5	Preventive dentistry expert	72,5	
6	Preventive dentistry expert	77,5	

Statistical tests using ICC (Intraclass et al.) assess inter-rater reliability. An ICC value of

0.750 falls into the "good reliability" category. This shows good consistency between the assessments given by the six experts. The following Statistical Test Results are outlined in the table below:

Table 1. SPSS Model Tooth Protection Test Results

	Intraclass Correlation
Average Measures	.750

Intraclass Correlation Coefficient, two-way mixed.

3. Revision
   After receiving input from experts regarding the model that has been prepared, several revisions have been made for improvement, including educational materials equipped with more detailed practical guidelines on how to brush teeth correctly for children and the importance of maintaining consistent oral hygiene, the addition of micronutrient intake materials such as calcium, phosphorus, and vitamin D explained in more detail as part of the prevention of caries and stunting. And the addition of interactive educational media.
4. User Eligibility Test
   The user trial was applied to mothers of toddlers in the toddler class of Karsamenak village, Kawalu Health Center, Tasikmalaya City. The average result of the feasibility score was 90.67, which is in the category of very feasible without revision. The following is the frequency distribution of user eligibility results:

Table 2. User Due Diligence Results

No	Category	F	%	Mean
1	**Highly Feasible**	**11**	**61,1**	**90,67**
2	**Feasible**	**7**	**38,89**	
3	**Moderately Feasible**	**0**	**0**	
4	**Not Feasible**	**0**	**0**	
5	**Highly not Feasible**	**0**	**0**	

The ICC test result is 0.860, which is a good reliability interpretation. The following are the results of the ICC test:

Table 1. SPSS Test Results on Tooth Protection Model Users

	Intraclass Correlation
Average Measures	.860

• *Intraclass Correlation Coefficient, two-way mixed.*

The research findings demonstrate the significant feasibility of the Tooth Protection Model based on two key parameters. First, the Intraclass Correlation Coefficient (ICC) value of 0.860 indicates excellent inter-rater reliability in evaluating this model. This ICC value approaching 1.0 demonstrates strong consistency in assessment and agreement among evaluators, confirming that the Tooth Protection Model has clear standards and can be uniformly interpreted by various users.

Furthermore, the user feasibility test results in Table 2 show that the majority of respondents (61.1%) rated this model as "Very Feasible" with an average score of 90.67, while 38.89% rated it as "Feasible". This distribution of ratings concentrated in positive categories indicates that the Tooth Protection Model has successfully met the acceptability and applicability criteria in preventing dental caries and stunting in toddlers. The absence of ratings in the "Moderately Feasible", "Not Feasible", and "Very Not Feasible" categories reinforces the conclusion that this model has been well-designed and aligns with user needs. These findings align with developing effective health interventions, where user engagement and acceptance are critical to successful program implementation.

The Tooth Protection model is a comprehensive approach designed to prevent dental caries and reduce the risk of stunting in children. The results of expert validation and user eligibility tests show that the Tooth Protection Model is worth using. The feasibility of this model can be attributed to the Theory of Social Determinants of Health developed by WHO. This theory emphasizes that health is influenced by various social, economic, and environmental factors [24]. The validated Tooth Protection model addresses these health determinants through its holistic approach, including nutrition, hygiene, and healthcare.

The tooth protection model consists of several interlocking vital stages. The first stage of Model Tooth Protection is education and awareness raising. This model emphasizes the importance of dental and oral health education for parents,

including proper brushing techniques and healthy eating habits.

Awareness campaigns such as the "21 Days of Clean Children's Teeth Challenge" are used to build children's toothbrushing habits. The use of applications has been proven to help mothers at home maintain the health of children's teeth and teeth [25]. This approach is in line with the findings of Rauber et al. (2021), who emphasized the importance of dental health for preschool children's growth and quality of life [2].

The second stage focuses on balanced nutrition. This model encourages exclusive breastfeeding during the first 6 months and the introduction of nutritionally balanced complementary foods. Sugar consumption restrictions are also emphasized in this model. This is due to the research of Achmad et al. (2020), which identified the relationship between diet and dental caries in preschool children [26]. Saliva pH maintenance is the third stage in this model, which involves increasing water intake and feeding naturally alkaline foods to maintain the pH balance of saliva. This approach relates to research showing the impact of sugar on oral pH and caries development [27].

The fourth stage of the Tooth Protection Model is the control of Streptococcus mutans. This model emphasizes good oral hygiene, oral antiseptics, and oral probiotics. This approach relates to the relationship between oral bacteria and dental caries in children [28]. The last stage involves administering CPP-ACP and MI Varnish. Remineralizing products such as CPP-ACP and MI Varnish are recommended to strengthen tooth enamel and prevent demineralization [23], [29].

The Tooth Protection model integrates various aspects of dental and oral care with stunting prevention and strategies for preventing dental caries and promoting good nutrition. Through the implementation of this model, it is hoped that there will be a decrease in the prevalence of dental caries and stunting in children, thereby improving their overall health and quality of life.

Conclusion

This study succeeded in developing the Tooth Protection Model as a comprehensive approach to prevent dental caries and stunting in toddlers. This model integrates dental health education, balanced nutrition, saliva pH maintenance, bacterial control, and remineralized products. The results of expert validation and user feasibility tests show that this model is feasible to implement, with significant potential to reduce the prevalence of dental caries and stunting in children.

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