

The Role of Maternal Perception Based on The Health Belief Model in Oral Health Behavior and Dental Caries Occurrence Among Young Children with Stunting: A Systematic Review

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ABSTRACT

Stunting and Early Childhood Caries (ECC) remain major public health problems, particularly in low- and middle-income countries. Maternal perception plays a crucial role in determining children's oral health behaviors because mothers are the primary caregivers and decision-makers in the family. This systematic review aimed to synthesize current evidence on the role of maternal perception based on the Health Belief Model (HBM) in influencing children's oral health behavior, dental caries occurrence, and its relationship with stunting. A Systematic Literature Review (SLR) was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Twenty eligible primary studies published between 2021 and 2025 were identified from the ScienceDirect database based on predefined inclusion criteria and analyzed using a narrative synthesis approach. The findings indicate that the HBM constructs perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and self-efficacy significantly influence maternal oral health practices, including supervising toothbrushing, using fluoride toothpaste, limiting sugary food consumption, and utilizing preventive dental services. These preventive behaviors are consistently associated with a lower incidence of Early Childhood Caries. Furthermore, untreated dental caries may contribute to stunting through impaired nutritional intake, chronic inflammation, and growth disruption. In conclusion, maternal perception based on the Health Belief Model is an important determinant of children's oral health behavior and may indirectly support stunting prevention. Integrating family-based oral health promotion into maternal and child health programs could improve both oral health and child growth outcomes.

Keywords: health belief model; maternal perception; oral health behavior; early childhood caries; stunting

INTRODUCTION

Stunting remains a major public health problem affecting children worldwide, particularly in low- and middle-income countries. It results from chronic undernutrition during critical periods of growth and development and is associated with impaired physical growth, cognitive development, immune function, and overall quality of life [1]. Beyond its systemic consequences, stunting has also been linked to poor oral health conditions. Children with stunting are more likely to experience reduced salivary flow, altered saliva composition, delayed tooth eruption, and a higher susceptibility to oral diseases, particularly dental caries [2].

Oral and dental health is a crucial component of child health because it directly influences eating function, growth, development, and quality of life. Dental caries remains the most prevalent oral disease among children worldwide, with a particularly high burden among preschool-aged children. In Indonesia, dental caries remains a major public health concern, with a national prevalence of 43.6%, while the prevalence among children aged 5–9 years and 10–14 years reaches 49.9% and 37.2%, respectively [3]. Various studies have shown that oral health behaviors, particularly regular toothbrushing with fluoride toothpaste and the use of appropriate water sources, are significantly associated with a lower incidence of dental caries among children [4].

Early Childhood Caries (ECC) is one of the most common chronic diseases in childhood despite being largely preventable. The consequences of ECC extend beyond oral health problems and include pain, infection, impaired mastication, sleep disturbances, reduced nutritional intake, and diminished quality of life [1]. Untreated dental caries may also trigger chronic inflammation and interfere with children's ability to consume adequate nutrients, thereby affecting growth and development. Research has shown that pain caused by dental caries can disrupt eating habits, sleeping patterns, learning activities, and productivity, ultimately leading to poorer quality of life [3]. Furthermore, chronic inflammation caused by untreated caries may suppress hemoglobin production and contribute to broader health problems [3].

The relationship between oral health and child growth has attracted increasing attention in recent years. Severe dental caries has been associated with an increased risk of stunting through multiple pathways, including chronic inflammation, pain during mastication, reduced food intake, and impaired nutritional status [1]. Similarly, children with stunting tend to have poorer oral hygiene conditions and a higher prevalence of dental caries compared with children who experience normal growth [2]. These findings suggest a bidirectional relationship between oral health and nutritional status that may contribute to adverse health outcomes during childhood.

In addition to dental caries, periodontal disease represents another important oral health problem characterized by chronic inflammation resulting from microbial plaque accumulation. The progression of periodontal disease is influenced not only by microbiological factors but also by imbalances between oxidative stress and antioxidant defense mechanisms, which stimulate inflammatory mediator release and periodontal tissue destruction [5]. Likewise, oral diseases in general have been associated with elevated inflammatory mediators that contribute to systemic health problems [6]. These findings indicate that oral health is shaped by complex biological, behavioral, and environmental interactions, emphasizing the need for comprehensive preventive approaches [5].

Because young children rely heavily on parental care, particularly maternal care, mothers play a central role in shaping children's oral health behaviors. Evidence suggests that parents with better oral health knowledge are more likely to supervise toothbrushing practices, regulate sugar consumption, and utilize preventive dental services, thereby reducing the risk of dental caries among children [7]; [8]. Similarly, oral health behavior is influenced by knowledge, beliefs, enabling factors, and reinforcing factors within the family environment, all of which affect health-related decision-making and preventive practices [9]. The Health Belief Model (HBM) provides a widely recognized theoretical framework for understanding health-related behaviors.

The model consists of perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, and cues to action, which collectively influence an individual's decision to engage in preventive health behaviors [1]. Within the context of children's oral health, maternal perceptions based on HBM constructs have been shown to significantly affect toothbrushing habits, utilization of dental services, and caries prevention practices [7]. Consequently, maternal beliefs and perceptions may indirectly influence children's oral health outcomes, including dental caries occurrence and its subsequent effects on nutritional status and growth.

If oral health behaviors are inadequate, dental caries can progress into more severe inflammatory conditions involving dental tissues and the pulp. Persistent inflammation may result in tissue destruction and disruption of normal oral biological functions [10]. Moreover, untreated dental caries has been shown to affect children's emotional and social well-being, causing anxiety, concerns about appearance, reduced confidence, and reluctance to participate in social and academic activities [3]. Therefore, dental caries should be considered not only an oral health problem but also a condition with broader implications for child development, well-being, and quality of life.

Although previous studies have separately investigated maternal perceptions, children's oral health behaviors, dental caries, and the association between oral health and stunting, evidence integrating these factors within the Health Belief Model framework remains limited. Existing systematic reviews primarily focus on the relationship between stunting and oral health without comprehensively addressing the behavioral mechanisms underlying maternal decision-making and preventive practices [2]. Consequently, a comprehensive synthesis linking maternal HBM-based perceptions, children's oral health behaviors, dental caries occurrence, and stunting is still lacking. Therefore, this systematic review aimed to synthesize current evidence regarding the role of maternal perception based on the Health Belief Model in shaping children's oral health behaviors, influencing dental caries occurrence, and its relationship with stunting. The findings are expected to identify current evidence, highlight existing research gaps, and provide recommendations for family-based oral health promotion and stunting prevention programs.

MATERIALS AND METHODS

This study employed a Systematic Literature Review (SLR) following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to synthesize evidence regarding the role of maternal perception based on the Health Belief Model (HBM) in influencing children's oral health behavior, dental caries, and stunting. To complement the review, a bibliometric analysis was conducted using VOSviewer version 1.6.20 to identify research trends and conceptual relationships among the selected studies.

PRISMA Analysis

The literature search was conducted in PubMed, Scopus, and ScienceDirect using combinations of Medical Subject Headings (MeSH) and free-text keywords related to Health Belief Model, maternal perception, oral health behavior, dental caries, stunting, and young children with Boolean operators (AND/OR). The search included English-language, full-text primary studies published between 2011 and 2026.

Eligibility criteria were established using the PICOS (Population, Interest, Comparison, Outcome, Study Design) framework. The population consisted of mothers or primary caregivers of children aged 0–6 years, including children with stunting or chronic malnutrition. The review included studies examining maternal perceptions, beliefs, or attitudes toward children's oral health based on the complete HBM or its constructs (perceived susceptibility, perceived

severity, perceived benefits, perceived barriers, self-efficacy, and cues to action). Outcomes included oral health behaviors (e.g., toothbrushing, dietary control, dental visits) and dental caries indicators (ECC, dmft/DMFT, or PUFA). Observational (cross-sectional, cohort, case-control) and qualitative studies were included, whereas systematic reviews, editorials, conference abstracts, protocols, case reports, and other non-original publications were excluded.

The study selection followed four PRISMA stages: identification, screening, eligibility, and inclusion. A total of 300 records were identified (PubMed = 98, Scopus = 117, ScienceDirect = 85). After removing 15 duplicates, 285 articles underwent title and abstract screening. Twenty studies were assessed for full-text eligibility, and all met the inclusion criteria for qualitative synthesis (Figure 1).

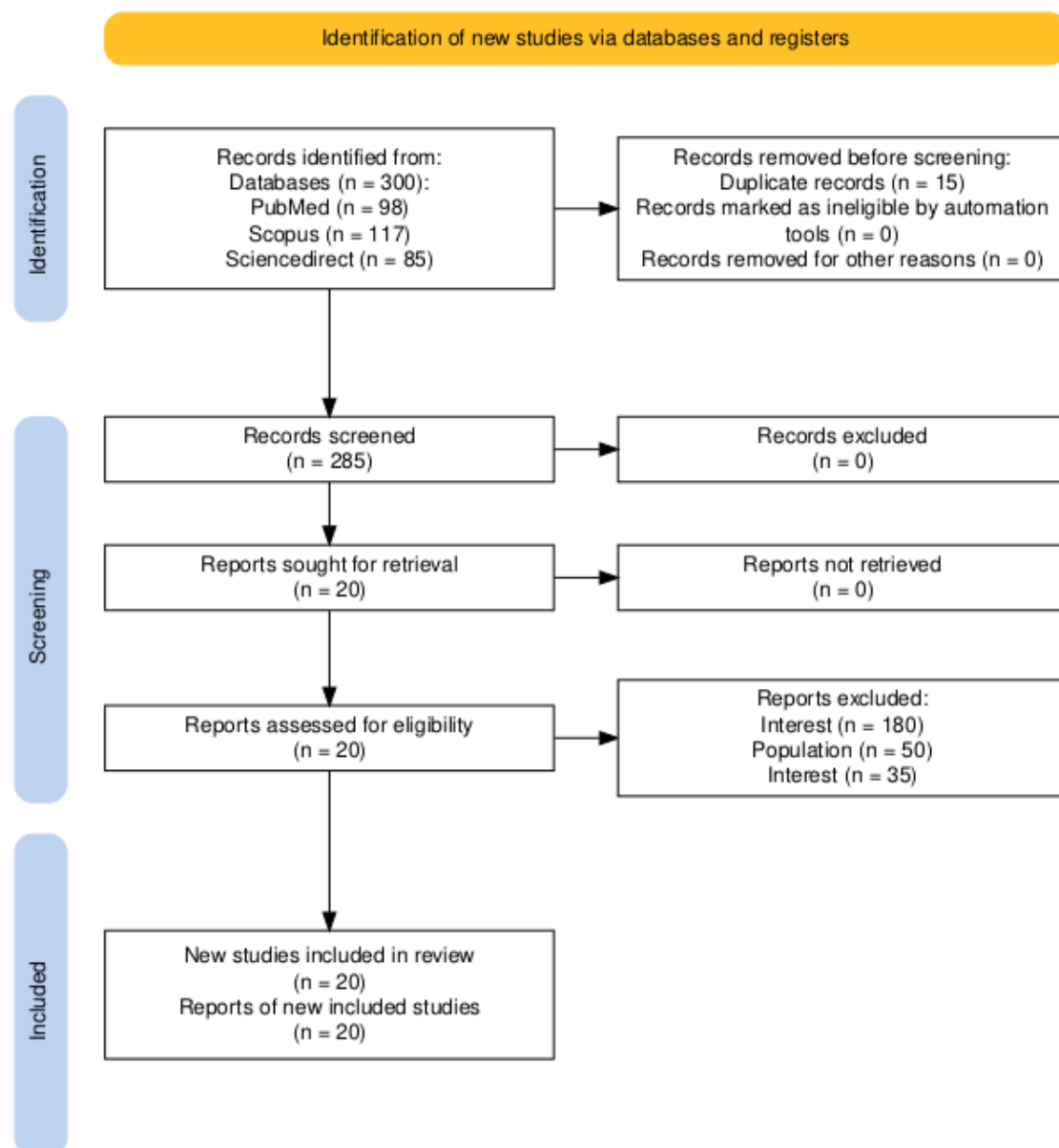


FIGURE 1: PRISMA 2020 flow diagram.

BIBLIOMETRIC ANALYSIS

Bibliometric mapping was performed using VOSviewer version 1.6.20. Bibliographic data from PubMed, Scopus, and ScienceDirect were merged after duplicate removal. Author and indexed keywords were standardized to eliminate spelling inconsistencies and synonymous terms before conducting a keyword co-occurrence analysis using the full counting method.

The analysis identified three thematic clusters (Figure 2). The green cluster represented HBM

constructs and preventive oral health behavior; the red cluster focused on maternal perception, child characteristics, and stunting; and the blue cluster covered methodological and clinical topics, including dental caries, early childhood caries, and systematic reviews. The network showed the Health Belief Model as the central node linking maternal perception with oral health behavior, while stunting, children, parental perception, and dental caries acted as key connecting concepts, highlighting the limited integration of these topics in previous studies.

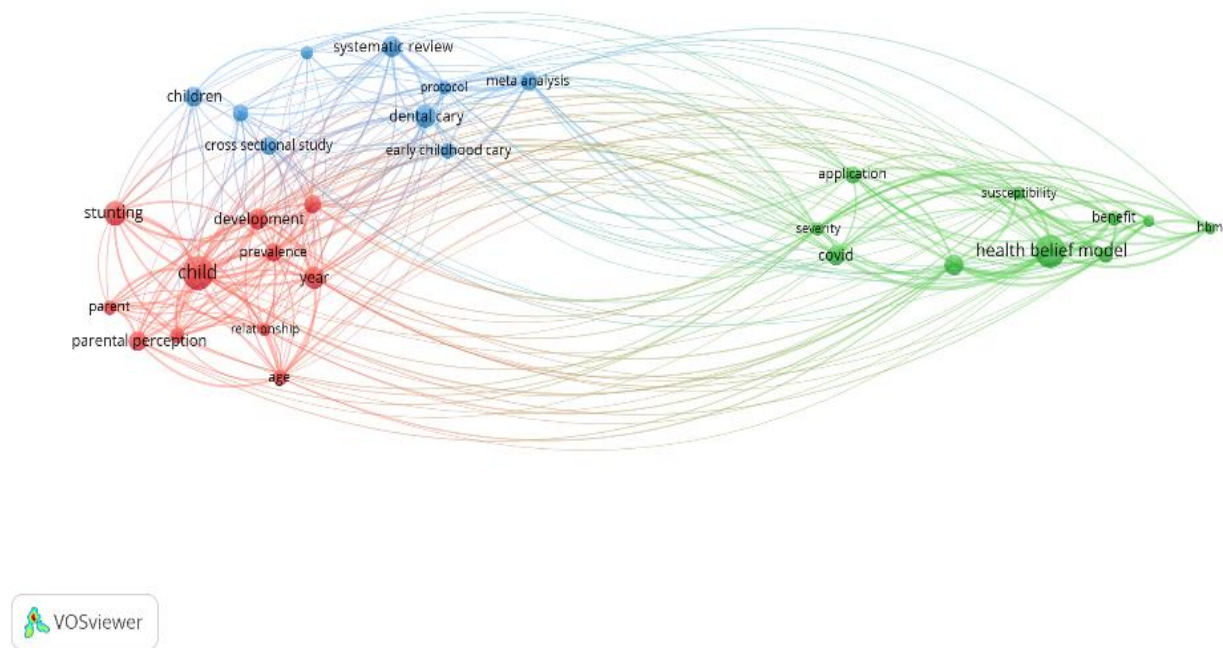


FIGURE 2: Keyword co-occurrence network visualization generated using VOSviewer.

RESULTS AND DISCUSSION

Maternal Perception Based on the Health Belief Model and Children's Oral Health Behavior

Maternal perception is a crucial factor influencing children's dental health behaviors from an early age. Within the Health Belief Model (HBM), the mother's or caregiver's perceptions of their child's perceived susceptibility to caries, perceived severity, perceived benefits, perceived barriers, and self-efficacy play a role in shaping health decisions and practices for their children. These perceptions influence various preventive behaviors, such as regular tooth brushing,

use of fluoride toothpaste, limiting sugary foods, regular visits to the dentist, and acceptance of caries prevention interventions.

Based on the literature selection process, 20 primary studies met the inclusion criteria. These studies came from various countries and featured diverse research designs, including cross-sectional, cohort, qualitative, and intervention studies. Study characteristics, including authors, population, outcomes, key findings, and significance to the systematic review topic, are presented in Table 1.

TABLE 1: Summary of the Included Studies.

No.	Author (Year)	Population	Outcome	Key Findings	Significance
1	Liu et al., (2024) [7]	1,562 parents and preschool children (3–6 years), China	HBM constructs, oral health behaviors, ECC, OHRQoL	Parental perceived benefits, perceived barriers, self-efficacy, perceived susceptibility, and perceived severity were significantly associated with toothbrushing behavior, ECC, and oral health-related quality of life.	Demonstrates the applicability of the Health Belief Model in explaining parental oral health behavior and children's dental outcomes.
2	Khan et al., (2021) [11]	92 preschool children (4–6 years) and their parents	Toothbrushing behavior, plaque, gingival status, dental caries	Toothbrushing technique, duration, frequency, parental supervision, and fluoride toothpaste use were significantly associated with plaque reduction and lower caries prevalence.	Highlights the importance of parental involvement in establishing effective oral hygiene practices among preschool children.
3	Kitsaras et al., (2021) [12]	185 parents of children aged 3–7 years	Bedtime oral hygiene, dietary habits, dmft	Frequent toothbrushing before bedtime was negatively associated with dmft, while frequent bedtime snacks and sugary drinks increased caries risk.	Demonstrates that parental supervision of bedtime routines contributes to better oral health outcomes.
4	Divdar et al., (2021) [13]	108 pregnant women	Oral health knowledge, attitude, self-efficacy, oral hygiene practice	Text-message interventions significantly improved oral health knowledge, attitude, behavioral intention, self-efficacy, oral hygiene practices, and dental plaque scores.	Supports the importance of improving maternal self-efficacy and health beliefs to enhance preventive oral health behaviors.
5	Mallineni et al., (2023) [14]	268 Saudi preschool children	Toothbrushing frequency, previous dental visits, dmft	Higher toothbrushing frequency and preventive dental visits were associated with lower dental caries experience.	Reinforces that preventive behaviors encouraged by parents reduce children's caries burden.
6	Pranno et al., (2022) [15]	204 parents accompanying children aged 3–12 years	Parental oral hygiene habits, fluoride knowledge, preventive behavior	Parents with better oral hygiene knowledge were more likely to adopt preventive practices and use fluoride toothpaste appropriately for their children.	Indicates that parental knowledge and behavior strongly influence children's oral health practices.
7	Pakkhesal et al., (2021) [16]	350 preschool children (3–6 years) and their parents	dmft, ECOHIS	Higher dmft scores were significantly associated with poorer oral health-related quality of life for both children and parents.	Demonstrates the broader impact of dental caries on family well-being and emphasizes the importance of prevention.
8	Sudjatmoko et al., (2025) [17]	108 Indonesian children aged 6–9 years	Nutritional status, dental maturation, mandibular bone density	Poor nutritional status significantly delayed dental maturation, although mandibular bone density was not significantly affected.	Provides evidence linking nutritional status, including stunting-related conditions, with children's oral development.
9	Singh & Talmale, (2023) [18]	1,214 adolescents (12–15 years), India	DMFT, BMI, OHRQoL	Dental caries and nutritional status were significantly associated with oral health-related quality of life.	Supports the interaction between nutritional status and oral health outcomes.

No.	Author (Year)	Population	Outcome	Key Findings	Significance
10	Fathallh et al., (2024) [19]	87 school children aged 12 years	DMFT, cariogenic bacteria, salivary IgA, nutritional status	Malnutrition was associated with increased caries susceptibility and poorer oral health indicators.	Strengthens evidence that poor nutritional status contributes to adverse oral health outcomes in children.
11	Renggli et al., (2021) [1]	1,595 Cambodian children aged <24 months	Severe dental caries, stunting, feeding practices	Children with severe dental caries had nearly twice the risk of developing stunting one year later (OR = 1.8). Severe ECC was identified as a potential contributor to impaired linear growth.	Provides strong epidemiological evidence linking severe early childhood caries with subsequent stunting, supporting the bidirectional relationship between oral health and child growth.
12	Nagda et al., (2024) [20]	60 children (3–10 years) with Autism Spectrum Disorder and typically developing peers, together with their parents	Toothbrushing practices, parental knowledge, home-care challenges	Parents of children with ASD reported greater difficulty maintaining daily oral hygiene. Children brushed less frequently, parents encountered more barriers, and access to a dental home was more limited.	Demonstrates that parental capability, knowledge, and caregiving burden directly influence children's oral hygiene behaviors and access to preventive dental care.
13	Teste et al., (2021) [21]	756 French children with Autism Spectrum Disorder and their parents	Toothbrushing difficulties, parental experiences, preventive strategies	Most parents experienced substantial toothbrushing difficulties. Planning routines, modeling behavior, and making brushing enjoyable were the main strategies adopted. Many parents reported insufficient education regarding oral hygiene management.	Highlights the importance of parental education, behavioral support, and professional guidance in improving children's oral hygiene practices.
14	Wajahat et al., (2022) [22]	197 parents of children aged 2–10 years	Parental perception and acceptance of silver diamine fluoride (SDF) for caries management	Most parents accepted SDF treatment after receiving professional explanations. Dentist recommendation was the strongest determinant of treatment acceptability, whereas aesthetics and treatment cost remained major concerns.	Indicates that parental perception toward preventive dental treatment can be modified through professional communication, supporting the role of health beliefs in treatment decision-making.
15	Bag, (2022) [23]	97 parents of preschool children aged 36–72 months	Parents' oral health attitudes, children's oral health practices, and non-cavitated caries lesions	Parents' knowledge regarding caries prevention, timing of first oral hygiene, toothbrushing frequency, and children's dietary habits were significantly associated with non-cavitated caries lesions. Early oral hygiene practices and regular toothbrushing reduce the risk of early caries.	Demonstrates that parents' oral health knowledge and preventive behaviors play an important role in preventing early childhood caries.

No.	Author (Year)	Population	Outcome	Key Findings	Significance
16	Chou et al., (2025) [24]	6,902 preschool children (3–5 years) and their caregivers in Taiwan	Health Belief Model constructs, caregiver oral health beliefs, self-efficacy, perceived barriers, oral health behaviors, and Early Childhood Caries (ECC)	Higher parental education, better child oral health behaviors, lower perceived barriers, and greater parental self-efficacy were significantly associated with a reduced risk of Early Childhood Caries (ECC). Among mothers, child oral health behaviors, perceived barriers, and self-efficacy were stronger predictors of ECC than among fathers, highlighting the central role of maternal health beliefs in children's oral health outcomes.	Provides strong longitudinal evidence that maternal health beliefs, self-efficacy, and perceived barriers based on the Health Belief Model significantly influence children's oral health behaviors and the risk of Early Childhood Caries, supporting the development of family-centered and gender-specific oral health interventions.
17	Chai et al., (2022) [25]	49 parents participated in a kindergarten outreach dental program	Parents' perspectives toward outreach dental services and SDF therapy	Oral health education improved parents' dental knowledge, children's oral health awareness, and parent-assisted toothbrushing. Parents accepting SDF prioritized caries prevention over aesthetics, whereas non-accepting parents were mainly concerned about black staining and possible toxicity.	Demonstrates that parental beliefs influence preventive treatment acceptance and children's oral health behavior.
18	Birant et al., (2023) [26]	396 parents of pediatric dental patients	Parents' knowledge, attitudes, and behaviors toward dental radiography	Parents with greater knowledge about dental radiography showed significantly more positive attitudes. Previous experience with dental radiographs and educational level also improved parental acceptance.	Indicates that improving parental knowledge enhances positive attitudes toward pediatric dental procedures and preventive dental care.
19	Hashem et al., (2022) [27]	2,690 parents of primary school children in Saudi Arabia	Parents' knowledge and perspectives regarding dental caries	Most parents demonstrated only moderate knowledge regarding dental caries and early clinical signs. Better knowledge promoted earlier recognition of caries and encouraged timely dental visits for prevention and treatment.	Highlights the importance of increasing parental awareness to improve early detection and prevention of childhood dental caries.
20	Hariyani et al., (2024) [28]	22 caregivers of children with Autism Spectrum Disorder (ASD)	Caregivers' perceptions, beliefs, behaviors, and dental caries experience	Caregivers of children with dental caries commonly expressed fatalistic beliefs, low self-efficacy, and perceived caries as less serious. In contrast, caregivers of caries-free children emphasized early prevention, consistent oral hygiene, and parental commitment.	Provides strong evidence that caregivers' perceptions, beliefs, and oral health behaviors influence children's dental caries experience, supporting the application of the Health Belief Model (HBM).

Based on the 20 studies included (Table 1), maternal perception, knowledge, and health beliefs consistently influenced children's oral health behaviors across different populations and study designs. Most studies reported that higher maternal knowledge and positive health beliefs were associated with regular toothbrushing, fluoride toothpaste use, reduced sugar consumption, and greater utilization of preventive dental services. Conversely, limited knowledge, low self-efficacy, and perceived barriers were associated with poorer oral hygiene practices and increased risks.

Studies applying the Health Belief Model consistently demonstrated that perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and self-efficacy were significant determinants of preventive oral health behaviors [7]; [24]. Likewise, educational interventions targeting maternal beliefs improved oral health knowledge, behavioral intention, and self-efficacy, leading to better preventive practices [13].

Similar findings were reported across observational and qualitative studies, which emphasized the importance of parental supervision, early oral hygiene practices, and professional communication in promoting children's oral health [11]; [12]; [15]; [22]; [25]. These findings collectively support the central role of maternal perception in shaping preventive oral health behaviors.

These findings can be further interpreted through the Health Belief Model as a framework of motivational readiness rather than merely a model of health knowledge. Preventive behavior is more likely to occur when caregivers perceive their children as susceptible to oral disease, recognize the potential severity of dental problems, believe that preventive actions provide meaningful benefits, and perceive barriers as manageable. Self-efficacy further determines whether caregivers feel capable of consistently performing preventive practices, while cues to action, such as reminders, social encouragement, and professional advice, may facilitate the transition from intention to actual behavior [29]. Therefore, maternal knowledge alone may not be sufficient to ensure appropriate oral health practices; interventions should also strengthen maternal confidence, reduce perceived barriers, and provide practical triggers that support sustained preventive behavior.

Maternal Perception and Dental Caries Among Young Children

The included studies consistently showed that maternal perception was closely associated with the occurrence of Early Childhood Caries (ECC). Mothers with better knowledge, higher self-efficacy, and stronger preventive beliefs were more likely to recognize early signs of caries, seek timely dental care, and adopt preventive oral health practices [27]; [23].

HBM-based studies further demonstrated that perceived susceptibility, perceived severity, perceived barriers, and self-efficacy significantly influenced ECC risk. Educational interventions improved self-efficacy and preventive behaviors, whereas fatalistic beliefs and low confidence were associated with higher caries prevalence [13]; [28]; [24].

These findings agree with previous studies indicating that improving maternal health beliefs through education and professional communication can reduce ECC by strengthening preventive behaviors and increasing acceptance of preventive interventions such as Silver Diamine Fluoride [25]; [22].

The influence of maternal perception on dental caries should also be understood within the sociocultural and environmental context in which caregiving occurs. Health beliefs are not formed independently of family norms, educational background, access to health information, or contact with health services. In some communities, dental caries in primary teeth may be normalized as an inevitable childhood condition, which can reduce perceived susceptibility and severity and consequently delay preventive action or professional care. Maternal preventive behavior may also be constrained by limited resources, insufficient support, or low health literacy, even when mothers recognize the importance of oral hygiene [29]. These contextual factors suggest that improving maternal perception requires not only increasing knowledge but also addressing culturally embedded beliefs and practical barriers that influence everyday oral health decision-making.

Oral Health Behavior, Dental Caries, and Stunting

The reviewed studies consistently demonstrated an association between oral health behavior, dental caries, and children's nutritional status. Regular toothbrushing, fluoride use, dietary control, and preventive dental visits were associated with lower caries prevalence [11]; [14]; [15].

Several studies further indicated that untreated ECC negatively affected children's quality of life and growth. Renggli et al. (2021) [1] reported that children with severe ECC had nearly twice the risk of developing stunting one year later (OR = 1.8) [1]. Similar findings were reported by Sudjatmoko et al. (2025) [17], Singh and Talmale (2023) [18], and Fathallh et al. (2024) [19], suggesting a bidirectional relationship between malnutrition and oral health.

Overall, the evidence suggests a pathway in which maternal perception influences oral health behavior, oral health behavior affects dental caries occurrence, and untreated caries contributes to stunting. These findings highlight the importance of integrating family-based oral health promotion into stunting prevention programs.

From a programmatic perspective, these findings indicate that family-based oral health promotion should extend beyond conventional information delivery. Effective interventions should combine belief modification with maternal empowerment, barrier reduction, social reinforcement, and culturally appropriate support. Participatory approaches that involve mothers and other relevant community actors may strengthen self-efficacy and encourage greater ownership of preventive oral health practices. Moreover, because the HBM primarily addresses individual cognitive perceptions, its application may be strengthened by incorporating social and environmental support that enables caregivers to translate positive beliefs into sustained behaviors (29). Such an approach may help establish preventive oral health practices as part of everyday family routines rather than as temporary responses to existing dental problems.

CONCLUSION

This systematic review demonstrates that maternal perception based on the Health Belief Model (HBM) plays an important role in shaping children's oral health behaviors and reducing the risk of Early Childhood Caries (ECC). Positive maternal health beliefs, knowledge, and self-efficacy promote preventive behaviors, including regular toothbrushing, fluoride toothpaste use, healthy dietary practices, and utilization of preventive dental services. The evidence also suggests that untreated dental caries may contribute to stunting, highlighting the interrelationship between maternal perception, oral health behavior, dental caries, and child growth. These findings emphasize the importance of integrating family-centered oral health promotion based on the HBM into maternal and child health and stunting prevention programs. Future longitudinal and intervention studies are needed to confirm the effectiveness of HBM-based interventions in improving children's oral health and growth outcomes.

ACKNOWLEDGEMENTS

The authors would like to thank all researchers whose studies were included in this systematic review. The authors also express their gratitude to the institution for providing academic support throughout the completion of this study. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

- [1] Renggli, E. P., Turton, B., Sokal-Gutierrez, K., Hondru, G., Chher, T., Hak, S., & Ramos-Gomez, F. (2021). Stunting malnutrition associated with severe tooth decay in Cambodian toddlers. *Nutrients*, 13(1), Article 290. <https://doi.org/10.3390/nu13010290>
- [2] Sadida, Z. J., Indriyanti, R., & Setiawan, A. S. (2021). Does growth stunting correlate with oral health in children?: A systematic review. *Thieme Medical and Science Publishers*, 10(1), 32–40.
- [3] Theresia, T. T., Andayani, L. H., Souliissa, A. G., & Lestari, S. (2026). Dental caries and quality of life among primary school children. *Dental Journal (Majalah Kedokteran Gigi)*, 59(2), 120–125.
- [4] Korwanich, K., Korwanich, N., & Chakkrawan, C. (2026). The effect of fluoride use, oral healthcare behavior, and water sources on the prevalence of dental caries in preschool-aged children in Thailand. *Dental Journal (Majalah Kedokteran Gigi)*, 59(2), 148–154.
- [5] Nedumaran, N., & Rajasekar, A. (2026). Therapeutic potential of thymoquinone gel in stage II grade A periodontitis: A prospective clinical and biochemical evaluation. *Dental Journal (Majalah Kedokteran Gigi)*, 59(2), 172–177.
- [6] Prasetyo, E. P., Sampoerno, G., Eka, D., Cahyani, F., Saraswati, W., Kuntjoro, M., & Soetojo, A. (2023). Effect of lipopolysaccharide-induced apical periodontitis in diabetes mellitus rats on periapical inflammation. *European Journal of Dentistry*, 17(4), 1146–1152.
- [7] Liu, S. M., Xin, Y. M., Wang, F., Lin, P. C., & Huang, H. L. (2024). Parental health belief model constructs associated with oral health behaviors, dental caries, and quality of life among preschool children in China: A cross-sectional study. *BMC Oral Health*, 24, Article 1497.
- [8] Nursal, D. G. A., Kasuma, N., Reno, W. W. H. A., Roza, D., Setiawan, I., Juwita, D. R., & Rahmadani, F. (2025). Stunting and its effects on salivary biomarkers and oral health: A cross-sectional analysis of flow rate, pH, and buffering capacity. *The Open Dentistry Journal*, 19, Article e18742106366969.
- [9] Berniyanti, T., Wening, G. R. S., Palupi, R., Setyowati, D., & Putri, C. R. (2022). Low levels of tumor necrosis factor- α will prevent periodontitis exacerbation in type 2 diabetes mellitus. *International Journal of Dentistry*, 6(2), 443–448.
- [10] Ismiyatin, K., Soetedjo, A., Sukaton, Noor, T. N. E. T. A., Sar, P. T., Anggraeni, F., & Yuanita, T. (2026). Effects of epigallocatechin-3-gallate and nano-hydroxyapatite on bone morphogenetic protein-2 expression and formation of odontoblast-like cells in rats with inflamed dental pulp. *Dental Journal (Majalah Kedokteran Gigi)*, 59(2), 166–171.
- [11] Khan, I. M., Mani, S. A., Doss, J. G., Danaee, M., Yi, L., & Kong, L. (2021). Pre-schoolers' tooth brushing behaviour and association with their oral health: A cross sectional study. *BMC Oral Health*, 21, Article 283. <https://doi.org/10.1186/s12903-021-01643-8>

- [12] Kitsaras, G., Goodwin, M., Kelly, M. P., & Pretty, I. A. (2021). Bedtime oral hygiene behaviours, dietary habits and children's dental health. *Children*, 8(5), Article 416.
- [13] Divdar, M., Araban, M., Heydarabadi, A. B., Cheraghian, B., & Stein, L. A. R. (2021). Effectiveness of message-framing to improve oral health behaviors and dental plaque among pregnant women. *Archives of Public Health*, 79, Article 117.
- [14] Mallineni, S. K., Allassaf, A., Almulhim, B., & Alghamdi, S. (2023). Influence of tooth brushing and previous dental visits on dental caries status among Saudi Arabian children. *Children*, 10(3), Article 471.
- [15] Pranno, N., Zumbo, G., Tranquilli, M., Stamegna, L., & Zara, F. (2022). Oral hygiene habits and use of fluoride in developmental age: Role of parents and impact on their children. *BioMed Research International*, 2022, Article 711.
- [16] Pakkhesal, M., Riyahi, E., Alhosseini, A. N., Amdjadi, P., & Behnampour, N. (2021). Impact of dental caries on oral health related quality of life among preschool children: Perceptions of parents. *BMC Oral Health*, 21, Article 68.
- [17] Sudjarmoko, A. R., Santoso, S., & Yanuaryska, R. D. (2025). Effect of nutritional status on dental maturation and mandibular bone density among Indonesian children aged 6–9 years in Yogyakarta. *Journal of Oral Biology and Craniofacial Research*, 15(2), 428–432. <https://doi.org/10.1016/j.jobcr.2025.02.010>
- [18] Singh, S., & Talmale, P. (2023). Impact of dental caries and nutritional status on oral health related quality of life in young Indian adolescents. *Journal of Oral Biology and Craniofacial Research*, 13(4), 506–510. <https://doi.org/10.1016/j.jobcr.2023.05.002>
- [19] Fathallah, A., Al-Sudani, F., Almuhsen, S., & Hassoon, S. (2024). The impact of malnutrition on dental health of 12-year-old children: A study on permanent teeth caries, cariogenic bacteria and salivary IgA. *Folia Medica*, 66(4), 515–520.
- [20] Nagda, R., Le, T., Lin, B., & Tanbonliong, T. (2024). Oral hygiene practice and home-care challenges in children with autism spectrum disorder in San Francisco: Cross-sectional study. *Special Care in Dentistry*, 44(3), 837–844.
- [21] Teste, M., Broutin, A., Marty, M., Valéra, M. C., Cunha, F. S., & Esclassan, N. E. (2021). Toothbrushing in children with autism spectrum disorders: Qualitative analysis of parental difficulties and solutions in France. *European Archives of Paediatric Dentistry*, 22, Article 640. <https://doi.org/10.1007/s40368-021-00640-3>
- [22] Wajahat, M., Abbas, B., Tariq, K., & Imran, E. (2022). Parental perception of silver diamine fluoride for the management of dental caries. *Journal of Taibah University Medical Sciences*, 17(3), 408–414. <https://doi.org/10.1016/j.jtumed.2021.11.010>
- [23] Bag, I. (2022). The attitudes of parents toward the oral health of children and their reflection on the non-cavitated caries lesions. *Pediatric Dental Journal*, 32(3), 26–33.
- [24] Chou, Y. C., Cheng, F. S., Weng, S. H., Tseng, C. H., Hu, H. Y., & Liu, C. H. (2025). Impact of parental health beliefs on early childhood caries: A two-year longitudinal study. *International Dental Journal*, 75(1), Article 100902. <https://doi.org/10.1016/j.identj.2025.100902>
- [25] Chai, H. H., Chen, K. J., Duangthip, D., Lo, E. C. M., Chu, C. H., & Gao, S. S. (2022). Parental perspectives on the use of silver diamine fluoride therapy to arrest early childhood caries in kindergarten outreach dental services: A qualitative study. *Journal of Dentistry*, 125, Article 104250. <https://doi.org/10.1016/j.jdent.2022.104250>
- [26] Birant, S., Ilisulu, S. C., & Ozcan, H. (2023). Parents' perspective towards dental radiography for children. *Journal of Dental Sciences*, 18(1), 1778–1785.
- [27] Hashem, D., Hammad, O. A., Farran, J., Faran, A., & Odeh, N. D. (2022). Perspectives on dental caries: A cross-sectional study among parents of primary school children in Saudi Arabia. *The Open Dentistry Journal*, 16, Article e187421062201060.
- [28] Hariyani, N., Oktarina, Shoaib, L. A., Rohani, M. M., Hanna, K. M. B., & Lee, H. (2024). Caregivers' perceptions, beliefs and behavior influence dental caries experience in children with autism spectrum disorder: A qualitative study. *The Saudi Dental Journal*, 36(12), 1533–1538. <https://doi.org/10.1016/j.sdentj.2024.09.019>
- [29] Wening, G. R. S., Mayasari, Y., Panjaitan, C. C., Hollanda, G. H., & Pinasti, R. A. (2025). Designing oral health promotion program: A behavioral approach. IPKESGIMI Publishing.