

## Introduction

Enamel is one of the most highly mineralized tissues in the human body, composed of about 97% inorganic material. In contrast, dentin consists of approximately 70% inorganic material. The primary mineral in both enamel and dentin is hydroxyapatite, which plays a critical role in maintaining structural integrity and resistance to wear.<sup>1</sup> Despite their inherent robustness, teeth remain vulnerable to demineralization caused by acidic challenges stemming from dietary sugars, plaque biofilm, and environmental factors. If left unchecked, this demineralization can lead to dental caries—a significant global health concern, particularly in children.<sup>2</sup>

Fluoride has long been the cornerstone of caries prevention due to its ability to enhance remineralization and inhibit bacterial activity.<sup>3</sup> However, concerns among parents regarding excessive fluoride exposure in children have spurred interest in alternative remineralizing agents. Nano-hydroxyapatite (nHA), a synthetic form of hydroxyapatite engineered at the nanoscale, has emerged as a promising biomimetic material. It has been shown to effectively integrate into the enamel matrix, promoting repair and reducing sensitivity.<sup>4</sup>

Research has demonstrated that nHA toothpaste can repair demineralized enamel by filling microscopic defects and occluding dentinal tubules, addressing both caries prevention and dentinal hypersensitivity.<sup>5</sup> At the nanoscale, nHA particles closely mimic natural enamel apatite crystals, allowing them to bind to damaged enamel surfaces and fill porous irregularities, thereby restoring surface integrity.<sup>6</sup> Additionally, nHA serves as a calcium phosphate reservoir, maintaining a state of supersaturation in the oral cavity, which further promotes remineralization.<sup>7</sup> Another advantage of nHA, as indicated by recent research, is its ability to effectively reduce oral biofilm without disrupting the natural oral microbiota.<sup>8</sup>

Several in vitro studies have highlighted the effective remineralization properties of nHA as compared to fluoride. However, many studies have not demonstrated a statistically significant difference between the two.<sup>2, 9, 10, 11</sup> Given growing concerns about fluorosis and systemic overexposure, nHA offers an attractive alternative. It has been shown to be biocompatible and safe, even if ingested, which strengthens its case for use in pediatric patients.<sup>12</sup>

Despite its potential, awareness and utilization of nHA toothpaste among pediatric dentists remain underexplored. Limited data exists on how frequently it is being recommended in clinical practice. This study aims to survey pediatric dentists and residents to assess their knowledge of nano-hydroxyapatite (nHA) toothpaste and whether they recommend it to their patients. By examining levels of awareness and clinical practices, this research seeks to identify educational gaps and potential barriers to nHA adoption. The findings could provide valuable insights into how nHA is perceived within the dental community and inform strategies for integrating this biomimetic material into mainstream pediatric oral care.

## Research Questions/Study Design

The goals of this study are to assess among pediatric dentists 1) their current knowledge and frequency of recommendation of nHA toothpaste, 2) their perceived efficacy and safety of nHA toothpaste, 3) the main barriers to recommendations, and 4) Determining differences in their perceptions based upon demographics such as length of time practicing and type of practice. Working hypothesis: The working hypothesis that we will explore is that Pediatric dentists are less likely to recommend nano-hydroxyapatite (nHAp) toothpaste to their patients due to lack of familiarity with its benefits and concerns about its long-term efficacy compared to traditional fluoride-based toothpastes.

This is a cross-sectional study in which data collection will occur over a period of one month, April 2025 - May 2025. A survey will be sent out via email to active American Academy of Pediatric Dentistry (AAPD) members. Data collection and analysis will then be completed by study personnel. The target population of this study will be active pediatric dentists and pediatric dental residents who are members of the AAPD. Recruitment will include an explanation of the study via email along with a link to complete the survey. This study hopes to obtain valuable insight into pediatric dentists' and residents' knowledge base on nHA toothpaste as well as factors influencing its recommendation.

## Results

How familiar are you with nanohydroxyapatite (nHAp) toothpaste?

Answered: 270 Skipped: 2

ANSWER CHOICES	RESPONSES	
Very familiar	20.00%	54
Somewhat familiar	60.37%	163
Not familiar	19.63%	53
TOTAL		270

In your practice, how often do you come across patients who request an alternative to fluoride toothpaste?

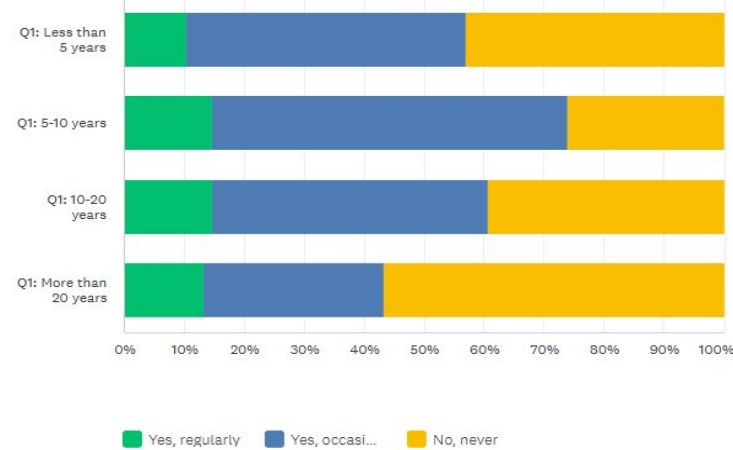
Answered: 269 Skipped: 3

ANSWER CHOICES	RESPONSES	
Frequently	26.39%	71
Occasionally	48.33%	130
Rarely	21.56%	58
Never	3.72%	10
TOTAL		269

Do you recommend nano-hydroxyapatite toothpaste to your pediatric patients?

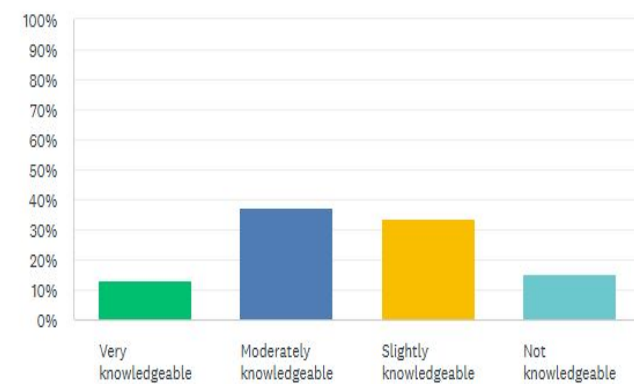
Answered: 272 Skipped: 0

ANSWER CHOICES	RESPONSES	
Yes, regularly	13.24%	36
Yes, occasionally	44.12%	120
No, never	42.65%	116
TOTAL		272



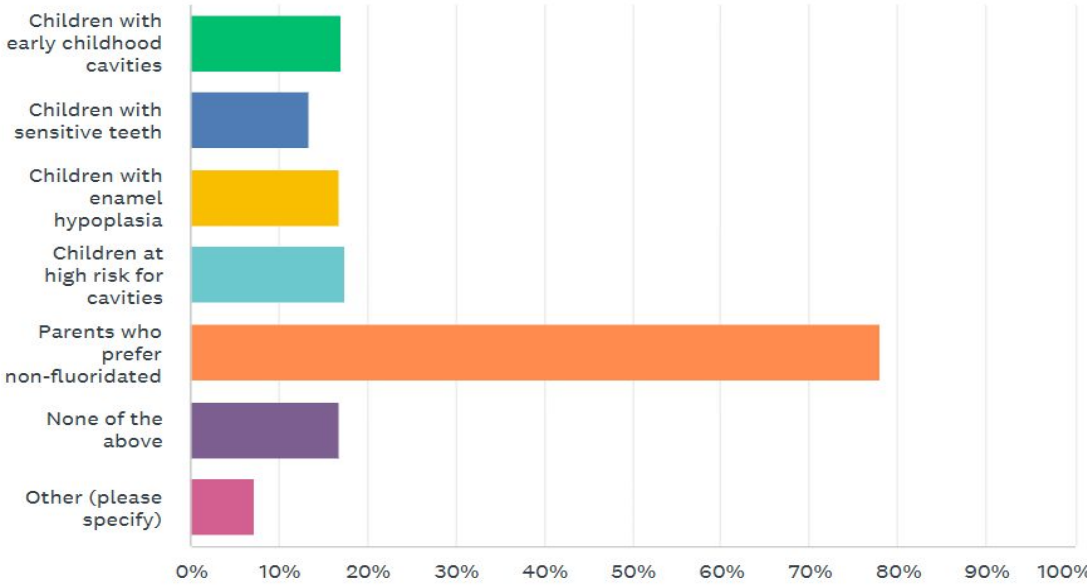
How would you rate your understanding of the mechanisms by which nanohydroxyapatite works in oral health (e.g., remineralization of enamel)?

Answered: 274 Skipped: 1



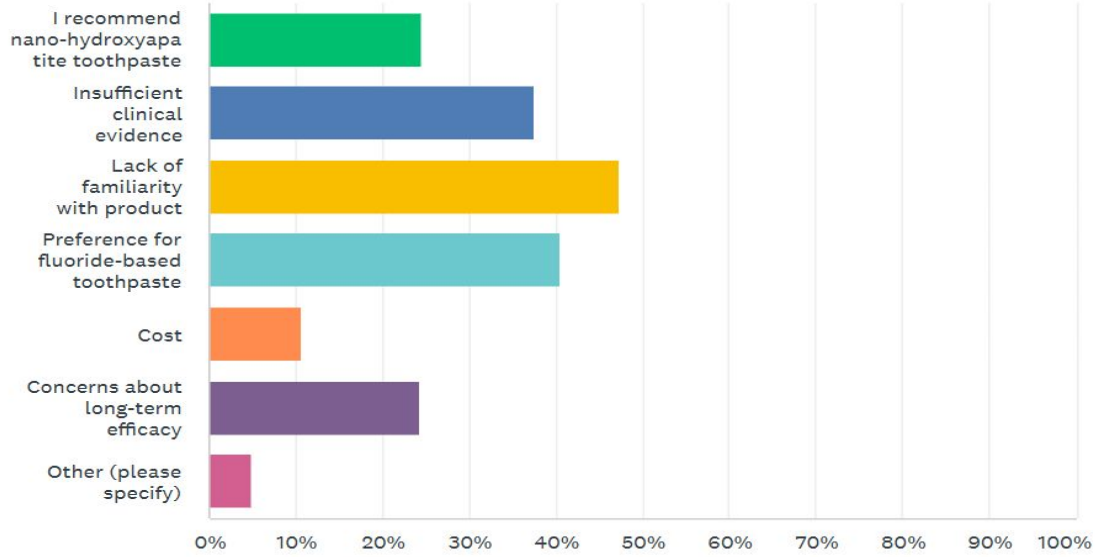
Under what circumstances are you most likely to recommend nano-hydroxyapatite toothpaste?

Answered: 274 Skipped: 1



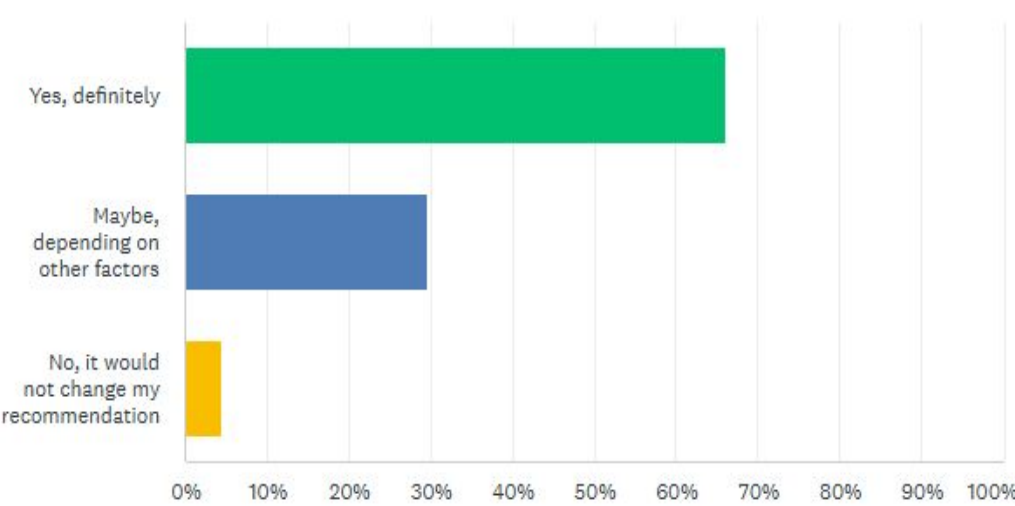
If you do not recommend nano-hydroxyapatite toothpaste, what are the primary reasons for not recommending it?

Answered: 264 Skipped: 11



Would you be more likely to recommend nano-hydroxyapatite toothpaste if more evidence based guidelines or recommendations from professional organizations were available?

Answered: 274 Skipped: 1



## Discussion

This survey explored the awareness, perceptions, and clinical adoption of nano-hydroxyapatite (nHAp) toothpaste among pediatric dental professionals. With 272 complete responses, the data reveals valuable insights into current trends and potential gaps in clinical practice regarding fluoride alternatives.

A significant proportion of respondents reported limited familiarity with nHAp, with many rating their understanding of its mechanism—particularly its role in remineralizing enamel—as moderate to low. Despite this, over a third of practitioners have recommended nHAp toothpaste, primarily in cases involving parental concern over fluoride exposure, early enamel demineralization, or sensitivity issues.

One of the strongest barriers identified in the survey was the perceived lack of robust scientific evidence and official clinical guidelines. A considerable portion of respondents stated they would be more likely to incorporate nHAp into patient care if there were clearer, evidence-based recommendations or endorsements by major dental organizations such as the AAPD. This highlights a major area for future progress: bridging the gap between emerging science and practical, clinical implementation through well-disseminated, trustworthy educational resources.

Interestingly, nearly half of respondents reported patient or parent inquiries about fluoride alternatives, underscoring growing public interest in non-fluoridated options. This presents an opportunity for pediatric dentists to bridge the gap between public curiosity and professional confidence through better information dissemination and training.

In conclusion, while the adoption of nano-hydroxyapatite toothpaste in pediatric dental practice is currently limited, there is clear interest and growing demand. The findings underscore the need for continued education, increased awareness, and the development of evidence-based guidelines to support clinicians. With these steps, nHAp has the potential to become a trusted, mainstream option in pediatric oral health care—especially for populations seeking fluoride-free solutions.

## References

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