Title

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Journal

International Dental Journal, 74(5)

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Publication Date

2024-10-01

DOI

10.1016/j.identj.2024.04.016

Peer reviewed

Concise Review

Recommendations on Topical Fluoride Usage for Caries Management in East Asia

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ARTICLE INFO

Article history:
Received 5 April 2024
Accepted 8 April 2024
Available online 12 June 2024

Key words:
Caries
Fluoride
Topical fluoride
Caries risk
Oral health

ABSTRACT

Dental caries is a widespread oral health issue in Asia, affecting an estimated 30% to 90% of children and adults. Many caries cases remain untreated, resulting in pain and infection. In response, the Asian Academy of Preventive Dentistry (AAPD) emphasises comprehensive caries management and organised a fluoride workshop at the 15th International Conference of the AAPD in 2023. The AAPD invited a group of experts to form a fluoride working group to review existing literature and develop fluoride recommendations for stakeholders across Asian countries and regions. The working group assessed caries risk and identified commonly used topical fluoride products for home care, professional, and community settings in Asia. The working group concluded that fluoride is a safe and highly effective strategy to reduce caries prevalence and incidence. The working group provided key recommendations based on successful regional caries management practices: (1) use topical fluoride for prevention and control of dental caries; (2) encourage the use of fluoride toothpaste with a concentration of at least 1,000 ppm for effective caries reduction; (3) advise a 0.05% fluoride mouth rinse as soon as children can spit it out to prevent early childhood caries; (4) deliver professionally administered fluoride, such as 5% sodium fluoride varnish, 2% fluoride gel, or 1.23% acidulated phosphate fluoride preparations, to decrease dental caries in at-risk individuals; and (5) apply 38% silver diamine fluoride to arrest cavitated caries. These recommendations aim to help practitioners, health care providers, and parents/caregivers make informed decisions about fluoride use as part of comprehensive oral health care in the region.

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https://doi.org/10.1016/j.identj.2024.04.016

Background

The Global Burden of Disease Study 2017 estimated that oral diseases affect around 3.5 billion individuals globally, with dental caries of permanent teeth being the most prevalent. Approximately 2.3 billion people worldwide are affected by dental caries of permanent teeth, whilst dental caries of primary teeth affect more than 530 million children.[1] In Asia, the prevalence of dental caries in children varies across different regions. In East Asia, caries prevalence ranges between 40% and 97%, whilst in South Asia, it is observed to be between 38% and 74%. West Asian countries report a range of 27% to 75% in terms of dental caries prevalence amongst children aged 3 to 12 years.[2] The widespread adoption of fluoride has played a significant role in reducing the occurrence and severity of dental caries in many Asian countries. Fluoride is a safe and effective method for preventing and managing dental caries, when used correctly.[3] The Asian Academy of Preventive Dentistry (AAPD) convened a workshop and invited a panel of experts during the 15th AAPD International Conference in November 2023 in Hong Kong. A fluoride working group was formed comprising a panel of health experts who reviewed the literature and developed topical fluoride recommendations for different stakeholders in Asian countries and regions. The objective of the workshop was to discuss and develop recommendations on topical fluoride usage for caries management in Asia. The AAPD intends these recommendations to help dental practitioners, health care providers, parents/caregivers, and older adults in the region make informed decisions concerning the appropriate use of fluoride as part of comprehensive oral health care for infants, children, adolescents, and adults.

Methods

The fluoride working group conducted a comprehensive review of scientific literature on the use of topical fluoride. The search, limited to literature in English, included the terms fluoride, fluoridation, fluoride gel, fluoride varnish, fluoride toothpaste, fluoride mouth rinse, silver diamine fluoride, fluoride therapy, and topical fluoride. In addition, other strategies—including reviewing references of other regional fluoride guidelines or recommendations, recent evidence-based reviews, and meta-analyses—were also employed. Due to the vast number of publications available in existing academic research databases, along with several high-quality evidence-based reviews published by other teams, it was decided to prioritise the thorough review of existing systematic reviews when drafting this recommendation. Several Asian countries have established their own guidelines or consensus statements on fluoride usage. The guidelines and consensuses were considered in conjunction with the systematic reviews in the eventual recommendation, ensuring practicality and applicability. Asian experts' opinions and current best practices were also considered in developing these recommendations.

Mechanism of fluoride in caries prevention

Fluoride exerts multiple mechanisms of action that contribute to its caries-protective effects. At a topical level, fluoride presence in dental plaque and saliva hinders the demineralisation of intact enamel and facilitates the remineralisation of demineralised enamel.[4,5] However, as dentine demineralises faster and remineralises more slowly than enamel under the same experimental conditions,[6,7] a higher concentration of fluoride is necessary to inhibit demineralisation and promote remineralisation of dentin compared to enamel.[8-10] Furthermore, fluoride influences the metabolic activity of cariogenic bacteria, thereby inhibiting the development of dental caries.[11,12]

Fluoride agents in East Asia

The fluoride working group identified commonly used topical fluoride products for home care, professional, and community settings across Asia, with an emphasis on affordability and widespread availability. After extensive research and discussion, the fluoride working group concluded that fluoride is not only a safe option but also a highly effective strategy in reducing the prevalence and incidence of dental health issues in the region. Table 1 presents a summary of the status of fluoride use in East Asia.

Water fluoridation

Water fluoridation is recognised as an equitable and cost-effective approach to ensuring fluoride delivery to all members of a community. More than 370 million people in more than 27 countries receive the benefits of water fluoridation.[13] So far, water fluoridation has been implemented in Asian countries and regions such as Hong Kong, Malaysia, Singapore, and Ho Chi Minh City in Vietnam.[14] Topical application of fluoride can reduce dental caries regardless of exposure to water fluoridation or other sources of fluoride.[15,16] Scientific evidence suggests that the cariostatic effect of fluoride is predominantly exerted through its topical application, rather than its systemic effect.[17] However, fluoridated water can improve dental health by raising fluoride levels when consumed directly or through supplements. It can also exert a similar protective effect against dental caries on the outer surface of fully mineralised, unerupted teeth. Topically applied fluoride that is later swallowed may have a systemic effect.[18]

Self-care fluoride therapy

Self-care fluoride administration products include toothpastes and fluoride mouth rinses. Fluoride toothpastes are widely used and have been proven effective against dental caries. A Cochrane review and a Swedish Council assessment provided the highest standard of evidence.[19,20] In a meta-analysis of 70 trials, the Cochrane Review found that fluoride toothpaste reduces dental caries in permanent teeth by an average of 24%.[19] Another Cochrane review also provides evidence that fluoride mouth rinse can be effective in preventing dental caries, with an average reduction of 27%.[21]

Table 1 – Summary of fluoride use in East Asia.

Country/region	Water fluoridation	Fluoride supplements (eg, salt, milk)	Fluoride (F) toothpaste	Common professionally applied fluoride agents
China	-	-	Up to 1,450 ppm F	- 5% Sodium fluoride varnish
Hong Kong	0.5 ppm	-	Up to 1,450 ppm F, 5,000 ppm (requires prescription)	- 5% Sodium fluoride varnish - 38% Silver diamine fluoride
Indonesia	-	-	-	- 5% Sodium fluoride varnish - 1.23% Acidulated fluoride gel - 30% Silver diamine fluoride
Japan	-	-	Up to 1,450 ppm F	- 5% Sodium fluoride varnish - 38% Silver diamine fluoride - 9,000 ppm Fluoride gel
Korea	0.6-1.0 ppm (not all Korea has introduced water fluoridation)	-	Up to 1,500 ppm F	- 5% Sodium fluoride varnish - 2% Neutral fluoride gel - 1.23% Acidulated fluoride gel
Malaysia	0.5 ppm	-	1,450 ppm F for adults, 600 ppm F for young children	- 1.23% Acidulated fluoride gel - 5% Sodium fluoride varnish
Singapore	0.5 ppm	-	Up to 1,450 ppm F	- 1.23% Acidulated fluoride gel - 5% Sodium fluoride varnish - 38% Silver diamine fluoride
Thailand	-	Milk fluoridation in limited areas from 2000–2018	Up to 1,500 ppm F	- 5% Sodium fluoride varnish - 38% Silver diamine fluoride - 1.23% Acidulated fluoride gel - 2% Sodium fluoride gel
Vietnam	0.5 ppm only in Ho Chi Minh City	Only implemented in remote mountain area	Up to 1,450 ppm F	- 0.2% Sodium fluoride solution - 0.5% Sodium fluoride solution - 38% Silver diamine fluoride - 5% Sodium fluoride varnish

Professionally applied fluoride therapy

Professionally applied topical fluoride treatments are effective in reducing the prevalence of dental caries. The most commonly used agents for professionally applied fluoride treatments are 5% sodium fluoride varnish and 1.23% fluoride gel. A Cochrane review conducted by the Cochrane review demonstrated that the application of 5% sodium fluoride varnish, which contains 22,600 ppm fluoride, can lead to a significant reduction of 37% in dental caries development amongst children and adolescents.[22] Another Cochrane review found that fluoride gel application can reduce dental caries development by 20% in children and adolescents. However, the quality of evidence supporting this finding is considered low.[23] Silver diamine fluoride is a clear ammonia solution containing silver and fluoride ions. It has been used for arresting dental caries. A systematic review reported that the overall rate of caries arrest by silver diamine fluoride was 81% in primary teeth.[24] One clinical trial showed no significant difference between 38% silver diamine fluoride and 5% sodium fluoride varnish on the effect in reducing dental caries.[25]

Caries risk assessment

The fluoride working group has developed topical fluoride recommendations grounded in caries risk assessment. As a result, it is essential for clinicians to conduct a thorough caries risk assessment prior to determining the appropriate course of fluoride therapy. By examining various risk factors such as oral hygiene practices, dietary habits, current fluoride exposure, and past dental records, dental professionals can quickly intervene and implement preventive strategies to reduce caries risk. Regular monitoring and periodic reassessment of an individual's risk profile facilitate the continuous adaptation and optimisation of preventive measures and interventions, ensuring personalised and effective dental caries management. The fluoride working group emphasises the importance of conducting caries risk assessments to prioritise interventions and allocate resources, such as education, preventive treatments, and follow-up appointments, for individuals at a higher risk for caries development. The working group suggested assessing the following 10 factors to develop criteria for dental caries risk in a local context:

1. Presence of cavitated or noncavitated enamel lesions upon clinical examination
2. Extent of dental plaque accumulation
3. Frequency of cariogenic snack and drink consumption
4. Frequency of between-meal exposures
5. Frequency of between-meal exposure to nonwater drinks and exposure to nonwater drinks at bedtime (for ages 0–6 years)
6. Quality of saliva and salivary flow
7. Special health care needs or predisposing medical conditions
8. Individual or family history of untreated dental caries
9. Availability of fluoridated water/salt/milk/tea
10. Use of fluoride toothpaste and/or mouth rinses

The fluoride working group developed a modified Caries Management by Risk Assessment (CAMBRA)[26] form for ages 0

Table 2 – Modified CAMBRA form for ages 0 to 6 years (Adpted from Featherstone et al.[26]).

Patient Name: **Provider Name:**	**Reference Number:** **Date:**		
Caries risk assessment component* **(Check 'Yes' only in the appropriate non-shaded column)**	**Column1**	**Column2**	**Column3**
Score	**-1 per tick**	**+2 per tick**	**+ 3 per tick**
Biological or environmental risk factors – Question items		**Tick if Yes**	
1.Frequent snacking (more than 3 times daily)			
2.Uses bottle/non-spill cup containing beverages other than water/ Overnight feeding			
3.Parent/primary caregiver or sibling has current decay or a recent history of decay (see high risk description below)			
4.Family has low socioeconomic &/or low health literacy status			
5. Currently taking medications that induce hyposalivation			
Protective factors – Question items	**Tick if Yes**		
1.Lives in a fluoridated drinking water area			
2.Drinks fluoridated water			
3.Uses fluoride (F)-containing toothpaste at least two times daily-a smear for ages 0–2 years and pea size for ages 3–6 years of 1,000 ppm F.			
4.Has had fluoride varnish applied in the last 6 months			
Biological risk factors – Clinical examination		**Tick if Yes**	
1. Heavy dental plaque on the teeth (refer to the figure below)			
Disease indicators – Clinical examination			**Tick if Yes**
1. Evident tooth decay or white spot lesions			
2. Recent restorations due to caries in the last 12 months			
Column score			
Final Overall Caries Risk Assessment **Total score (Columns 2 + 3 −1):**			
☐Increased caries risk (1, 2: moderate, 3 or more: high caries risk) ☐Low caries risk (0 or negative score)	**Low** ☐		**Increased** ☐

Heavy dental plaque on the teeth in children

to 6 years (Table 2) and ages older than 6 years through adulthood (Table 3).

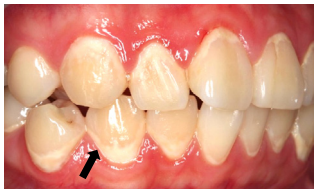
Summary of recommendations on topical fluoride usage

The fluoride working group has formulated topical fluoride recommendations based on different extents of caries risk (Table 4). These recommendations focus on strategies to reduce the burden of dental caries across the population, using topical fluoride agents. The recommendations are as follows:

1. Fluoride therapy is a safe and effective strategy for reducing dental caries prevalence and incidence.
2. Fluoridated toothpaste with a concentration of at least 1,000 ppm is effective in reducing dental caries.
3. Fluoride mouth rinse with a concentration of 200 to 900 ppm is recommended as soon as children can spit out.
4. 5% Sodium fluoride varnish is more effective than 2% sodium fluoride gel and 1.23% acidulated phosphate

Table 3 – Modified CAMBRA form for ages older than 6 years (Adapted from Featherstone et al.[26]).

Patient Name: **Provider Name:**	**Reference Number:** **Date:**		
Caries risk assessment component (Check 'Yes' only in appropriate non-shaded column)	**Column1**	**Column2**	**Column3**
Score	**-1 per tick**	**+2 per tick**	**+ 3 per tick**
Protective factors – Question items	**Tick if Yes**		
1. Drinks fluoridated water			
2. Uses fluoridated toothpaste at least once a day			
3. Uses fluoridated toothpaste 2X daily or more			
4. Uses 5,000 ppm fluoridated toothpaste			
5. Had fluoride varnish applied in the last 6 months			
6. Uses 0.05% sodium fluoride mouth rinse daily			
7. Uses 0.12% chlorhexidine gluconate mouth rinse daily for 7 days monthly			
8. Has normal salivary function			
Biological or environmental risk factors Question items		**Tick if Yes**	
1. Frequent snacking (more than 3 times daily)			
2. Currently taking hyposalivatory medications			
3. Currently on recreational drug use			
Biological risk factors - Clinical examination		**Tick if Yes**	
4. Heavy dental plaque on the teeth (refer to the figure below)			
5. Reduced salivary function (measured low flow rate)			
6. Deep pits and fissures on teeth			
7. Exposed tooth roots			
8. Orthodontic appliances			
9. Presence of removable prostheses			
Disease indicators – Clinical examination			**Tick if Yes**
1. New cavities or lesion(s) into dentin (radiographically)			
2. New white spot lesions on smooth surfaces			
3. New non-cavitated lesion(s) in enamel (radiographically)			
4. Existing restorations due to caries in the last 3 years for new patients or the last year for the patient of record			
Column score			
Final Overall Caries Risk Assessment **Total score (Columns 2 + 3 −1):**			
☐Increased caries risk (-1,0,1: moderate, >2 high caries risk) ☐Low caries risk (-8 to -2)	**Low** ☐		**Increased** ☐



Visible heavy plaque accumulation on permanent teeth in adults

Table 4 – Summary of recommendations on topical fluoride usage.

Products	Recommended use		Other instructions
	Low caries risk	Increased caries risk	
Self-care fluoride administration (home care)			
Fluoride (F) toothpaste (1,000–5,000 ppm F)			
• Younger than 3 years old	• Twice daily (once before bedtime) • A smear the size of a rice grain of 1,000 ppm F		• Start brushing as soon as the teeth erupt • Employ the correct brushing technique • Ensure an adequate brushing duration (at least 2 min) • For the standard fluoride toothpaste, the use of 1,450–1,500 ppm F toothpaste is strongly recommended wherever it is available • Consider using the highest available fluoride concentration if 5,000 ppm F toothpaste is not accessible in some regions; with this lower F toothpaste, the frequency of use could be adjusted to 3 times a day if deemed necessary and appropriate • Spit out any excess toothpaste and refrain from swallowing it
• 3–5 years old	• Twice daily (once before bedtime) • A pea-sized amount of 1,000 ppm F		
• 6 years old and older	• Twice daily (once before bedtime) • Standard fluoride toothpaste (1,000-1,500 ppm F)	• Twice daily for high-concentration fluoride toothpaste (5,000ppm) • Three times daily for standard fluoride toothpaste	
0.05% Sodium fluoride mouth rinse (220 ppm F)			
• As soon as children can spit out	-	• Twice daily • One-minute	Supervised use for young children, particularly those with special needs
Professionally applied fluoride (chairside/community care)			
5% Fluoride varnish (22,600 ppm F)	• Twice a year	• Four times a year	
2% Sodium fluoride gel (8,000 ppm F)	• Optional	• Four times a year	• Not for children younger than 6 years • Contraindicated in individuals with porcelain restoration
1.23% APF (12,300 ppm F)			
38% Silver diamine fluoride solution or gel* (44,800 ppm F)		• Twice a year	
Low caries risk: based on the modified CAMBRA results from the forms shown in Table 2 and 3.			
Increased caries risk: based on the modified CAMBRA results from the forms shown in Table 2 and 3. *: Arrest caries			
It is recommended that individuals seek professional caries risk assessment and consult with their dentist or oral health professional for personalized advice on fluoride usage and oral care. *CAMBRA, Caries Management by Risk Assessment.*			

fluoride in reducing dental caries in children and adults at caries risk.
5. 38% Silver diamine fluoride is recommended to arrest cavitated caries in young children.

Conflict of interest

None disclosed.

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