

MINISTRY OF EDUCATION AND TRAINING

MINISTRY OF HEALTH

**THAI BINH UNIVERSITY OF MEDICINE AND PHARMACY**

**HA VAN CHIEN**

**CURRENT STATUS OF DENTAL CARIES AND  
GINGIVITIS AND THE EFFECTIVENESS OF  
SELECTED INTERVENTION MEASURES  
AMONG PRIMARY SCHOOL STUDENTS  
IN DONG SON DISTRICT, THANH HOA PROVINCE**

**Major: Public Health**

**Code: 9720701**

**SUMMARY OF THE DOCTORAL DISSERTATION  
IN PUBLIC HEALTH**

**HUNG YEN - 2025**



## LIST OF PUBLISHED SCIENTIFIC WORKS RELATED TO THE DISSERTATION

1. Ha Van Chien, Le Duc Cuong, Nguyen Duc Thanh (2025). Status of dental caries among primary school students in Dong Son District, Thanh Hoa Province in 2022. *Vietnam Medical Journal*, No. 2, Vol. 557, pp. 93–97.
2. Ha Van Chien, Le Duc Cuong, Nguyen Duc Thanh (2025). Knowledge regarding the prevention of dental caries and periodontal diseases among primary school students in Dong Son District, Thanh Hoa Province in 2022. *Journal of Community Medicine*, No. 66, Vol. 21, pp. 338–344.
3. Ha Van Chien, Le Duc Cuong, Nguyen Duc Thanh (2025). Preventive practices for dental caries and periodontal diseases among primary school students in Dong Son District, Thanh Hoa Province in 2022. *Vietnam Journal of Community Medicine*, Vol. 66, Special Issue. 21, pp. 345–350.

## INTRODUCTION

Dental caries and gingivitis are currently the two most common oral diseases, affecting individuals of all ages and showing an increasing trend worldwide. Although they may appear to be minor conditions, if not detected and treated in a timely manner, they can lead to serious consequences such as prolonged pain, widespread infection, premature tooth loss, and adverse effects on general health. In addition, dental caries and gingivitis significantly reduce quality of life by causing difficulties in eating, communication, and daily activities.

Recent statistics indicate that more than 90% of the Vietnamese population have experienced or are currently experiencing oral health problems. Among children, reports show that over 86% of Vietnamese children suffer from dental caries, suggesting that dental caries are almost “as common as routine childhood illnesses.” A study conducted in several primary schools reported that 94.8% of children aged 6–11 years had at least one decayed tooth, with prevalences of 89.9% in primary (deciduous) teeth and 44.4% in permanent teeth. Primary school age represents the transitional period following preschool years, during which children undergo mixed dentition with the replacement of primary teeth. Inadequate oral hygiene practices, along with insufficient attention from families and schools, may result in unfavorable long-term consequences for students. This issue is of particular concern, as poor oral hygiene creates favorable conditions for the development of dental caries, thereby adversely affecting children’s overall health

The World Dental Federation (FDI) has also warned that Viet Nam is among the countries with a high prevalence of dental caries in children worldwide. Currently, the prevalence of dental caries in Viet Nam remains high and continues to increase, particularly in rural and mountainous areas. A study conducted by an author in Hanoi reported that the prevalence of early-stage permanent dental caries among 7–8-year-old students in Dong Ngac was 78.8% when permanent caries were calculated from early lesions at the D1 level, 48.4% from the D2 level, and 20.3% from the D3 level. In Viet Nam, numerous studies have investigated dental caries and gingivitis

across all age groups. Several intervention measures have been reported, such as oral health care interventions that achieved an effectiveness index of 20.61% [4]. A study by Tran Tan Tai reported a dental caries prevalence of 77.6% and a gingivitis prevalence of 33.2%. The authors also highlighted that health communication and education interventions yielded favorable outcomes [5]. In addition, Vu Manh Tuan demonstrated that the use of fluoride gel produced certain positive effects.

In Thanh Hoa Province, several studies on oral diseases have been conducted; however, no research has specifically focused on identifying preventive solutions for oral diseases among primary school students. The research questions addressed in this study were: What is the prevalence of dental caries and gingivitis among students in selected primary schools in Thanh Hoa Province? Which intervention measures can be applied to reduce disease prevalence and to improve students' knowledge and practices regarding the prevention of dental caries and gingivitis? Therefore, we conducted the study entitled "*Current status of dental caries and gingivitis and the effectiveness of selected intervention measures among primary school students in Dong Son district, Thanh Hoa Province*", with the following objectives:

1. To describe the current status, knowledge, and preventive practices related to dental caries and gingivitis among students in four primary schools in Dong Son (former district), Thanh Hoa Province, in 2022.

2. To evaluate the effectiveness of several multimodal interventions in improving knowledge and practices and in reducing the prevalence of dental caries and gingivitis among primary school students in the study area

### **Layout of the dissertation**

The dissertation comprises 118 pages. In addition to the Introduction (2 pages), Conclusion (2 pages), and Recommendations (1 page), the dissertation includes four chapters: Chapter 1: Literature Review (36 pages); Chapter 2: Study Subjects and Methods (17 pages); Chapter 3: Research Results (31 pages); Chapter 4: Discussion 29 pages. The dissertation includes 45 tables, 5 figures, and 131 references (Vietnamese: 60; English: 71).

## Chapter 1. LITERATURE REVIEW

### 1.1. Overview of dental anatomy and concepts of dental caries and gingivitis

Anatomically, teeth are hard structures with different shapes and functions, located on the jawbones. Their primary functions include chewing and tearing food, as well as supporting speech and facial aesthetics. Teeth are composed of three main layers: enamel, dentin, and pulp.

There are three stages of tooth eruption: **Stage 1:** Eruption of primary (deciduous) teeth, occurring from 6 to 30 months of age. **Stage 2:** Eruption of permanent teeth, occurring from 6 to 12 years of age. **Stage 3:** Eruption of third molars (wisdom teeth), occurring from 18 to 25 years of age. Among these, the second stage plays a particularly important role, as permanent teeth gradually replace primary teeth during this period. If primary teeth are properly cared for and exfoliate at the appropriate time, permanent teeth are more likely to erupt in proper alignment, with good aesthetics and reduced risk of oral diseases. Therefore, early prevention is essential to ensure that children develop healthy dentition, maintain good overall health, and reduce tooth loss in middle-aged and elderly populations.

Dental caries is a disease of the hard tissues of the teeth (enamel, dentin, and cementum), characterized by demineralization that progressively destroys inorganic and organic components of enamel and dentin, resulting in cavitation that is irreversible and requires clinical treatment.

**Early childhood caries (ECC)** is defined as the presence of one or more decayed (cavitated or non-cavitated), missing (due to caries), or filled tooth surfaces in any primary tooth in children aged 71 months or younger.

Gingivitis (inflammation of the gingiva) is a condition in which dental plaque containing bacteria accumulates on tooth surfaces, leading to inflammation of the gingival tissues. When plaque persists for a prolonged period, clinical signs of gingivitis become evident, including gingival irritation, inflammation, redness, swelling, bleeding, and exudation. Moreover, plaque bacteria can weaken tooth enamel. Gingivitis is highly prevalent and is often painless in its early stages, resulting in limited patient attention. However, timely treatment is essential, as gingivitis may progress to periodontitis and ultimately lead to tooth loss.

## 1.2. Current status of dental caries and gingivitis in children and knowledge and practices related to the prevention of oral diseases

\* *Worldwide:* A pooled analysis including 164 publications (81 studies on the prevalence of dental caries in primary teeth and 83 studies on the prevalence of dental caries in permanent teeth) was conducted. The results showed that the global prevalence of dental caries in children's primary teeth, with a sample size of 80,405, was 46.2% (95% CI: 41.6–50.8%), while the global prevalence of dental caries in children's permanent teeth, with a sample size of 1,454,871, was 53.8% (95% CI: 50.0–57.5%). In the United States, studies have also indicated a resurgence of dental caries, particularly early childhood caries. Specifically, approximately 37% of children aged 2–8 years had experienced dental caries in their primary teeth, including nearly 23% of children aged 2–5 years and 56% of those aged 6–8 years. Among these children, 14% had untreated dental caries in primary teeth. The prevalence of dental caries in permanent teeth among children aged 6–11 years was 21%, with the prevalence in the 9–11 age group being more than twice that in the 6–8 age group (29% versus 14%). Approximately 6% of children aged 6–11 years had untreated dental caries in permanent teeth, with rates of 8% among children aged 9–11 years and 3% among those aged 6–8 years.

\* *In Viet Nam:* Nguyen Quoc Trung reported that secondary school students had a high prevalence of dental caries, accounting for 81.4%; caries in tooth 46 showed the highest proportion at 58.5%, and lesions of tooth 6 assessed using the ICDAS index accounted for 28.4%. Nguyen Tien Bao and colleagues reported an overall dental caries prevalence of 31.8% (71 children), of which untreated dental caries accounted for 25.6%. The prevalence of dental caries increased with age (36.0% in the 5-year-old group compared with 25.0% in the 3-year-old group). Carious lesions were predominantly located in the mandible (85.9%). The prevalence of enamel hypoplasia was very high (92.8%), with 88.9% of children having four or more affected teeth. Gingivitis was observed in 12.1% of children, mainly of mild to moderate severity. These findings indicate that oral diseases are relatively prevalent among preschool-aged children; as children progress to school age, if adequate oral health care is not provided, the prevalence of dental caries is likely to continue to increase

**\* Knowledge and practices related to the prevention of oral diseases:**

Maintaining good oral hygiene is one of the most important measures for the prevention of dental caries. Proper oral hygiene helps prevent the development of dental caries by significantly reducing the accumulation of dental plaque on tooth surfaces. The composition of dental plaque varies not only among individuals but also according to different locations within the oral cavity and on different tooth surfaces. Control of bacterial plaque is achieved through appropriate personal oral hygiene practices (tooth brushing, use of dental floss, and mouth rinses), combined with professional dental interventions (such as scaling and removal of dental calculus).

Knowledge refers to an individual's understanding, which varies widely and often originates from personal experience or information transmitted by others. Individuals may acquire knowledge from teachers, parents, friends, colleagues, people in their surroundings, books, newspapers, and mass media. Understanding is not always consistent with formal knowledge, as information received from teachers, parents, peers, books, or the media may be incomplete or inaccurate. Misunderstandings are often difficult to change once incorrect perceptions become entrenched as fixed beliefs. Therefore, students' knowledge of oral hygiene and the prevention of dental caries differs across age groups and educational levels. Practice: Practices arise from understanding and knowledge; adequate knowledge leads to appropriate actions. Correct knowledge and positive attitudes result in proper practices, and conversely, inadequate knowledge and attitudes may lead to improper practices. Several previous studies have demonstrated this relationship.

**1.3. Selected intervention measures to reduce the prevalence of dental caries and gingivitis in children**

Since the early 20th century, the World Dental Federation (FDI) has been concerned with proposing intervention strategies for the prevention of oral diseases. The World Health Organization (WHO) has recommended specific measures for the prevention of dental caries and periodontal diseases, including:

**Use of fluoride:** Fluoridation of salt with a fluoride concentration of 250 mg F per 1 kg of salt.

***Pit and fissure sealants:*** Applied in cases where tooth surfaces have pits and fissures, particularly on the occlusal surfaces of molars, which are common sites for the development of dental caries.

***Appropriate diet:*** Control of sugary foods and beverages through measures such as regulating the availability of sugar-containing foods in schools, reducing the frequency of sugar intake, and decreasing overall sugar consumption at the national level.

***Oral hygiene education:*** Providing guidance to children and communities on a caries-preventive diet, proper tooth-brushing techniques, and other methods of maintaining oral cleanliness.

***Other measures:*** Regular dental check-ups every 6 months to 1 year for early detection and timely treatment of oral diseases; correction of malpositioned or supernumerary teeth, as these conditions facilitate food retention and increase the risk of dental caries; and health education and communication for children, parents, and caregivers directly involved in child care.

## **Chapter 2. RESEARCH SUBJECTS AND METHODOLOGY**

### **2.1. Research subjects, area, and duration**

#### ***2.1.1. Research subjects***

Primary school students in the study area.

#### ***2.1.2. Research area***

The study was conducted in four primary schools - Dong Hoang, Dong Quang, Dong Thanh, and Dong Think - located in Dong Son District, Thanh Hoa Province.

#### ***2.1.3. Research duration:***

- Baseline survey: conducted from March to May 2022 (mid-second semester).

- Implementation of intervention measures: over a 12-month period, from September 2022 to September 2023.

- Post-intervention survey: conducted in October 2023

### **2.2. Research methodology**

#### ***2.2.1. Research design***

- **Objective 1:** A cross-sectional descriptive study design.

- **Objective 2:** A controlled community-based intervention study design.

## 2.2.2. Sample size and sampling methods

### 2.2.2.1. Sample size

- Sample size for the cross-sectional survey to determine the prevalence of dental caries and gingivitis:

$$n = Z^2_{(1-\alpha/2)} \frac{pq}{e^2} \times DE \quad (1)$$

Based on the selected parameters, the required sample size for estimating the prevalence of dental caries was 836 students, while that for estimating the prevalence of gingivitis was 1,065 students. As the sample size required to estimate the prevalence of gingivitis was larger than that required for dental caries, the sample size for gingivitis prevalence was chosen to provide an overall assessment of both conditions. At each school and for each grade, all students from two classes were selected to ensure ethical considerations in the research. In practice, the final sample size consisted of 1,153 students.

- Sample size for the intervention study:

$$n = \frac{\{Z_{1-\alpha/2}\sqrt{2P(1-P)} + Z_{1-\beta}\sqrt{P_1(1-P_1) + P_2(1-P_2)}\}^2}{(P_1 - P_2)^2}$$

Based on the selected data, the calculated sample size for each group was 158 students. In reality, 295 students were selected for the intervention school and 269 students for the control school.

### 2.2.3. Variables and indicators in the study

\* *Dental caries and gingivitis:*

- Distribution of students by age and sex
- Overall prevalence of dental caries
- Overall prevalence of dental caries by age, sex, grade, and school
- Prevalence of dental caries in primary (deciduous) teeth by age, sex, grade, and school
- Prevalence of dental caries in permanent teeth by age, sex, grade, and school
- Prevalence of gingivitis in primary teeth by age, sex, grade, and school
- Prevalence of gingivitis in permanent teeth by age, sex, grade, and school

*\* Students' knowledge and practices*

+ Proportion of students with correct knowledge regarding dental caries and gingivitis, including causes, consequences, clinical signs, foods harmful to teeth, and preventive measures.

- Proportion of students with appropriate practices related to oral hygiene, dental caries, and gingivitis prevention, including timing of tooth brushing, frequency of brushing, duration of each brushing session, use of toothbrushes and toothpaste, habits related to consumption of sugary foods, and parental involvement in children's oral hygiene.

- Selected factors associated with oral diseases, including age, sex, dietary habits, oral hygiene behaviors, daily oral hygiene practices (frequency of tooth brushing, timing of toothbrush replacement, use of toothpaste, timing of brushing, use of mouth rinse, etc.), and the level of attention and support from families, schools, and school health services.

*2.2.3.2. Variables and indicators for Objective 2*

+ Intervention models and measures: description of the intervention model, forms, contents, and specific intervention measures.

+ Intervention effectiveness:

- Prevalence of overall dental caries among students before and after the intervention

- Prevalence of dental caries in primary (deciduous) teeth before and after the intervention

- Prevalence of dental caries in permanent teeth before and after the intervention

- Prevalence of gingivitis in primary teeth before and after the intervention

- Prevalence of gingivitis in permanent teeth before and after the intervention

- Proportion of students with appropriate oral hygiene practices before and after the intervention

- Proportion of students with correct knowledge of oral hygiene before and after the intervention

***2.2.4. Community-based intervention measures, implementation, and evaluation of intervention effectiveness.***

The intervention measures were categorized into three groups, including indirect health communication and education, direct health communication and education, and provision of practical support tools:

- **Indirect health communication and education measures:** These measures were implemented continuously throughout the intervention period to provide basic knowledge, reminders, and reinforcement of oral health care behaviors among students. Students in the intervention group received one educational leaflet containing concise, easy-to-understand content illustrated with clear visual images. Educational posters were displayed in easily observable locations within the school premises, such as classroom corridors, handwashing areas, and notice boards.

- **Direct health communication and education measures:** The study organized thematic educational sessions on oral health. One face-to-face educational session per month was conducted for students by healthcare professionals or school health staff.

- **Provision of practical support tools:** During the intervention period, students were provided with toothbrushes and toothpaste in three distribution rounds, each separated by a three-month interval. Distribution was carried out uniformly for all students in the intervention group, ensuring that each student had sufficient tools to practice proper oral hygiene and to maintain regular tooth-brushing habits

#### ***2.2.5. Data processing and analysis***

- Data were entered using EpiData 3.1 and analyzed using SPSS version 20.0.

- For Objective 1, data were analyzed using descriptive statistical methods and presented in the form of tables and figures in accordance with regulations. The Z-test and Chi-square test ( $\chi^2$  test) were used to assess differences between proportions, while the Student's t-test was applied to compare two means.

- For Objective 2, intervention outcomes were evaluated by comparing changes before and after the intervention within the intervention group and the control group, as well as by comparing the two groups to assess intervention effectiveness using appropriate effectiveness indices.

### 2.2.6. Ethical considerations

The study protocol was approved by the Scientific Review Board of Thai Binh University of Medicine and Pharmacy under Decision No. 43/QĐ-YDTB dated January 14, 2022.

All study participants were clearly informed about the objectives of the research. The study results will be communicated to local authorities to serve as a basis for improving oral health care activities for students.

During the implementation of Phase 2 of the study, students in all four participating schools continued to receive equal benefits from existing health care programs.

## Chapter 3. RESEARCH RESULTS

### 3.1. Current status of dental caries, gingivitis, and students' knowledge and practices related to disease prevention

#### 3.1.1. Current status of dental caries and gingivitis among students

*Table 3.1. Characteristics of students by sex, age group, and school (n = 1,153)*

Characteristics		No	Percentage (%)
Sex	Male	595	51,6
	Female	558	48,4
Grade (age group)	1 (6 years)	323	28,0
	2 (7 years)	260	22,5
	3 (8 years)	275	23,9
	4 (9 years)	295	25,6
School	Dong Quang	295	25,6
	Dong Thinh	304	26,3
	Dông Thanh	269	23,3
	Dong Hoang	285	24,8

The results in Table 3.1 show that among the surveyed students, males accounted for 51.3% and females 48.7%. The proportion of students by grade was highest in Grade 1 at 28.0% and lowest in Grade 2 at 22.5%. Students from the four surveyed schools each accounted for proportions ranging from 23.3% to 26.3%.

**Table 3.2. Proportion of students with dental caries by grade level**

Grade	Number surveyed	Type of dental caries					
		Deciduous teeth		Permanent teeth		Total dental caries	
		No	%	No	%	No	%
Grade 1 (6 years)	323	222	68.7	123	38.0	278	86.1
Grade 2 (7 years)	260	192	73.8	141	54.2	233	89.6
Grade 3 (8 years)	275	182	66.2	145	52.7	228	70.2
Grade 4 (9 years)	295	154	52.2	134	45.4	207	82.1
<b>Total</b>	1153	750	65.1	543	47.1	946	82.1

The results in Table 3.2 show that the prevalence of dental caries by grade was as follows: the prevalence of caries in deciduous teeth among Grade 1 students was 68.7%, Grade 2 was 73.8%, Grade 3 was 66.2%, and Grade 4 was 52.2%. The prevalence of caries in permanent teeth was 38.0%, 54.2%, 52.7%, and 45.4%, respectively. The overall prevalence was 80.1%, 89.6%, 70.2%, and 82.1%, respectively.

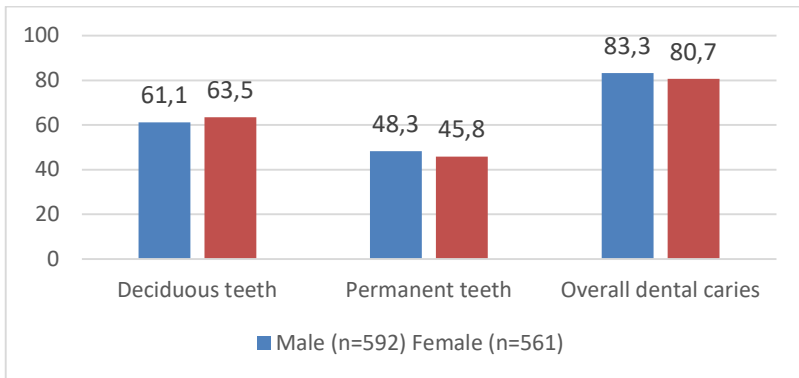
**Figure 3.1. Prevalence of dental caries among students by gender (n = 1153)**

Figure 3.1 shows that the prevalence of caries in deciduous teeth, permanent teeth, and overall dental caries among males and females was 63.5%–45.8%–80.7% and 61.1%–48.3%–83.3%, respectively.

**Table 3.3. Prevalence of gingivitis among students by grade level**

Grade	Number surveyed	Deciduous teeth		Permanent teeth	
		No	%	No	%
Grade 1 (6 years)	323	237	73.4	102	31.6
Grade 2 (7 years)	260	173	66.5	138	53.1
Grade 3 (8 years)	275	171	62.2	156	56.7
Grade 4 (9 years)	295	154	52.2	191	64.8
<b>Total</b>	1153	735	63.8	587	50.9

Table 3.3 shows that the prevalence of gingivitis was highest in Grade 1 at 73.4% and lowest in Grade 4 at 52.2%. For permanent teeth, the prevalence of gingivitis was highest in Grade 4 at 64.8% and lowest in Grade 1 at 31.6%.

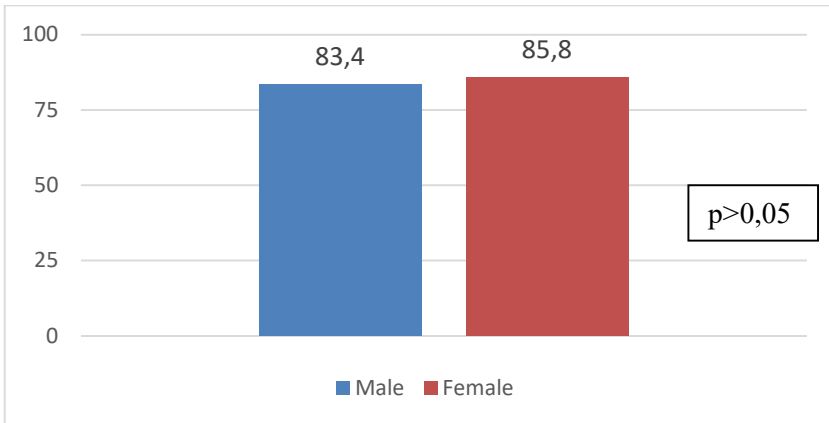
**Figure 3.2. Prevalence of gingivitis among students by gender (n = 1153)**

Figure 3.2 shows that the prevalence of gingivitis was 83.4% in male students and 85.8% in female students. The difference was not statistically significant ( $p > 0.05$ ).

**Table 3.4. Proportion of students who had heard about oral diseases and knew that they can be prevented (n = 1153)**

Content asked	Number	Percentage
Heard about oral diseases	927	80.4
Know that dental caries and gingivitis can be prevented	912	79.1

The results in Table 3.4 show that 80.4% of students had heard about oral diseases, and 79.1% of students believed that dental caries and gingivitis can be prevented.

**Table 3.5. Proportion of students with knowledge about the causes of dental caries, by school (n = 1153)**

Survey content	Surveyed schools								Total (n=1153)	
	Dong Quang (n=295)		Dong Thinh (n=304)		Dong Thanh (n=269)		Dong Hoang (n=285)			
	No	%	No	%	No	%	No	%	No	%
Not rinsing the mouth after meals	180	61.0	190	62.5	157	58.4	162	56.8	689	59.8
Poor oral hygiene	165	55.9	197	64.8	174	64.6	189	66.3	725	62.9
Eating a lot of sugary foods	171	57.9	182	59.8	183	68.0	167	58.6	703	60.9
Eating hard foods	186	63.0	191	62.8	178	66.2	156	54.7	711	61.7
Mean knowledge score	2.38/4		2.50/4		2.57/4		2.36/4		2.45/4	

Table 3.5 shows that the highest proportion of students identifying a cause of dental caries was eating hard foods (61.7%), while the lowest was not rinsing the mouth after meals (59.8%). The mean knowledge scores for the schools were 2.38/4, 2.50/4, 2.57/4, and 2.36/4, respectively, with an overall score of 2.45/4.

**Table 3.6. Proportion of students who know the signs of gingivitis (n = 1153)**

Survey content	No	Percentage
Bleeding gums	530	48.0
Toothache with bleeding gums when pressing	579	50.2
Mean knowledge score	1.44/3	

The proportion of students who knew about gingivitis by school showed that the most frequently identified sign was toothache with bleeding when pressing on the gums (50.2%), while other signs accounted for 48.0%.

**Table 3.7. Proportion of students practicing daily oral hygiene (n = 1153)**

Oral hygiene practices	No	Percentage
Rinsing the mouth after meals	541	46.9
Brushing teeth daily	671	58.2
Using a children's toothbrush	914	79.3
Using children's toothpaste	991	85.9
Replacing the toothbrush within $\leq 3$ months	644	55.8
Brushing teeth immediately after meals	571	49.5
Brushing teeth before going to bed	626	54.3
Brushing teeth after waking up	724	62.8
Brushing all three surfaces of the teeth	528	45.8
Brushing teeth at least twice a day	513	44.5
Parents guide children in toothbrushing	729	63.2
Parents regularly remind children	725	62.9

The results in Table 3.7 show that all daily oral hygiene practices were performed at relatively low rates. The lowest proportion was brushing teeth at least twice a day, at only 44.5% of students. This was followed by rinsing the mouth after meals (46.9%), brushing teeth after waking up (62.8%), brushing teeth daily (58.2%), using a children's toothbrush (79.3%), and using children's toothpaste (85.9%).

### 3.2. Effectiveness of selected multimodal intervention measures in improving knowledge and practices and reducing the prevalence of dental caries and gingivitis among students

**Table 3.8. Effectiveness in reducing the overall prevalence of dental caries among students (n=564)**

Survey content	Intervention school (n=295)		Control school (n=269)		IE (%)
	BI (1)	AI (2)	BI (3)	AI (4)	
Number	237	147	203	187	<b>30.1</b>
Percentage (%)	80.3	49.8	75.5	69.5	
IE (%)	38.0		7.9		
p-value	P(1&2) <0.01; P(3&4) >0.05; P(2&4) <0.01				

*BI: Before intervention; AI: After intervention*

Table 3.8 shows that after 12 months of intervention, the overall prevalence of dental caries among students decreased in both schools. At the intervention school, the prevalence decreased from 80.3% to 49.8%, with a statistically significant difference ( $p < 0.01$ ). At the control school, the prevalence decreased from 75.5% to 69.5%, but this difference was not statistically significant ( $p > 0.05$ ). The intervention effectiveness reached 30.1%.

**Table 3.9. Effectiveness in reducing the prevalence of gingivitis in deciduous teeth among students before and after the intervention (n = 564)**

Survey content	Intervention school (n=295)		Control school (n=269)		IE (%)
	BI (1)	AI (2)	BI (3)	AI (4)	
Number	177	97	174	157	<b>35.5</b>
Percentage (%)	60.0	32.9	64.7	58.4	
IE (%)	45.2		9.7		
p-value	P(1&2) <0.01; P(3&4) >0.05; P(2&4) <0.01				

The results in Table 3.9 show that the prevalence of gingivitis in deciduous teeth at the intervention school decreased from 60.0% to 32.9%, with a statistically significant difference ( $p < 0.05$ ). At the control school, the prevalence also decreased, but the difference was not statistically significant ( $p > 0.05$ ). The intervention effectiveness reached 35.5%.

**Table 3.10. Effectiveness in reducing the prevalence of gingivitis in permanent teeth among students (n = 564)**

Survey content	Intervention school (n=295)		Control school (n=269)		IE (%)
	BI (1)	AI (2)	BI (3)	AI (4)	
Number	191	92	124	108	<b>39.0</b>
Percentage (%)	64.8	31.1	46.1	40.1	
IE (%)	52.0		13.0		
p-value	P(1&2) <0.01; P(3&4) >0.05; P(2&4) >0.05				

The effectiveness in reducing the prevalence of gingivitis in permanent teeth is presented in Table 3.10. The results show that at the intervention school, the prevalence decreased from 64.8% to 31.1%, with a statistically significant difference ( $p < 0.01$ ). At the control school, the prevalence decreased from 46.1% to 40.1%, but this reduction was not statistically significant ( $p > 0.05$ ). The intervention effectiveness reached 39.0%.

**Table 3.11. Effectiveness in increasing the proportion of students with correct knowledge about the causes of dental caries (n = 564)**

Survey content	Intervention school (n=295)				Control school (n=269)				IE (%)
	BI (1)		AI (2)		BI (3)		AI (4)		
	No	%	No	%	No	%	No	%	
Not rinsing the mouth after meals	180	61.0	262	88.8	157	58.4	174	64.7	34.8
Poor oral hygiene	165	55.9	254	86.1	174	64.6	151	56.1	40.9
Eating a lot of sugary foods	171	57.9	258	87.4	183	68.0	189	70.3	47.5
p-value	p(1&2)<0.05; p(2&4)<0.05								

The results in Table 3.11 show that students' correct knowledge about the causes of dental caries increased markedly after the intervention compared with before the intervention, with the intervention effectiveness (HQCT) reaching a maximum of 47.5% and a minimum of 34.8%. The proportion of students who recognized that dental caries are caused by consuming a lot of sugary foods increased to 87.4% at the intervention school. This difference was statistically significant ( $p < 0.05$ ).

**Table 3.12. Effectiveness in increasing the proportion of students with correct knowledge about methods for preventing dental caries and gingivitis (n = 564)**

Survey content	Intervention school (n=295)				Control school (n=269)				Intervention school (n=295)
	BI (1)		AI (2)		BI (3)		AI (4)		
	No	%	No	%	No	%	No	%	
Brushing teeth three times a day after meals	178	60.4	280	94.9	162	60.2	196	72.9	36.0
Rinsing the mouth after meals	190	64.4	277	93.9	180	66.9	196	72.9	36.8
Replacing the toothbrush every 3 months	163	55.3	238	80.7	156	58.0	177	65.8	32.4
Regular dental check-ups	126	42.7	205	69.5	120	44.6	154	57.2	34.5
Limiting the consumption of sugary foods	175	59.3	290	99.3	165	61.3	193	71.7	50.5
p	P(1&2)<0.05; P(2&4)<0.05								

Table 3.12 shows that the intervention effectiveness for students' knowledge of dental caries and gingivitis prevention ranged from 32.4% to 50.5%. At the intervention school, 99.3% of students stated that limiting the consumption of sugary foods can help prevent dental caries. This difference was statistically significant ( $p < 0.05$ ).

**Table 3.13. Effectiveness in increasing the proportion of students practicing oral hygiene (n=564)**

Survey content	Intervention school (n=295)				Control school (n=269)				IE (%)
	BI (1)		AI (2)		BI (3)		AI (4)		
	No	%	No	%	No	%	No	%	
Rinsing the mouth after meals	147	49.8	286	96.9	124	46.1	176	65.4	53.8
Brushing teeth daily	182	61.7	291	98.6	156	60.5	200	74.3	37.0
Using a children's toothbrush	233	79.0	295	100	211	78.4	223	82.9	20.9
Using children's toothpaste	257	87.1	295	100	234	87.0	240	89.2	11.5
Replacing the toothbrush within $\leq 3$ months	168	56.9	246	83.4	146	54.3	142	52.8	43.9
Brushing teeth immediately after meals	146	49.5	209	70.8	135	50.2	148	55.0	33.5
Brushing teeth before going to bed	163	55.3	288	97.6	150	55.8	182	67.7	55.2
Brushing teeth after waking up	191	64.4	290	98.3	166	61.7	203	75.5	30.2
Brushing all three surfaces of	139	47.1	219	74.2	123	45.7	178	66.2	12.6

the teeth									
Brushing teeth at least twice a day	128	43.4	238	80.7	119	44.2	156	58.0	54.7
p	p <sub>(1&amp;2)</sub> <0.05; p <sub>(2&amp;4)</sub> <0.05								

Table 3.13 shows that students' oral hygiene practices after the intervention improved markedly. The use of children's toothpaste and toothbrushes reached 100%; 97.6% of students brushed their teeth before going to bed, and 98.3% brushed their teeth after waking up. The highest intervention effectiveness reached 54.7%, with a statistically significant difference ( $p < 0.05$ ).

## CHAPTER 4. DISCUSSIONS

### 4.1. Current status of dental caries, gingivitis, and students' knowledge and practices in disease prevention

#### 4.1.1. Current status of dental caries and gingivitis among students

Our study was conducted at primary schools in Dong Son District (former), Thanh Hoa Province. The schools included in the study were Dong Quang, Dong Thanh, Dong Thinh, and Dong Hoang Primary Schools. At these schools, we surveyed students in Grades 1, 2, 3, and 4 during Phase 1. In Phase 2, after one year of intervention, Grade 1 students advanced to Grade 2, Grade 2 to Grade 3, Grade 3 to Grade 4, and Grade 4 to Grade 5.

Our study assessed and evaluated the status of dental caries according to WHO criteria. The results showed that the prevalence of dental caries classified according to WHO standards was relatively high in all four schools. This may be attributed to the baseline characteristics of the surveyed population, most importantly the local economic conditions and the still limited implementation of dental caries prevention interventions.

The study results indicate that the overall prevalence of caries in deciduous teeth across all four schools was 65,1%. The prevalence of deciduous tooth caries among Grade 1 students was 68,7%, Grade 2 was 73,8%, Grade 3 was 66,2%, and Grade 4 was 52,2%. These findings show that the prevalence of deciduous tooth caries decreases progressively by

grade level, meaning that as students grow older, the prevalence of deciduous tooth caries declines. This trend can be explained by the process of tooth replacement: from Grades 1 to 4, children begin to lose deciduous teeth and permanent teeth erupt, leading to a reduction in the number of deciduous teeth and consequently, a decrease in the prevalence of deciduous tooth caries.

Our study also addressed gingivitis. The results showed that the prevalence of gingivitis in deciduous teeth across the schools was 63,6%. For permanent teeth, the prevalence of gingivitis was highest at Dong Quang School at 64,8%, while the other schools showed lower rates. Thus, the prevalence of gingivitis at Dong Quang School was higher than at the other schools. and the proportion of students with gingivitis at this school was also the highest. Gingivitis in deciduous teeth was highly prevalent and appeared similarly across different student groups, which may be due to shared characteristics such as oral hygiene habits, dietary patterns, or inconsistent levels of school-based dental care.

#### ***4.1.2. Students' knowledge and practices in preventing dental caries and gingivitis***

Understanding the causes of dental caries, Gingivitis, and halitosis helps students know how to prevent these conditions and reduce the risk of dental caries and gingivitis. It also improves overall health. as some oral diseases can affect nutrition (poor eating), sleep, and even immune function. Improved oral health enhances the quality of learning and daily activities, since healthier students are able to study and participate in activities more effectively. In addition, correct knowledge raises students' sense of personal responsibility, helping them understand that dental care is their own responsibility rather than depending on adults, thereby fostering discipline and independence. When students have proper understanding and practice good oral hygiene, the prevalence of disease within schools decreases, good habits are spread among peers. and the impact of oral diseases on systemic health is reduced.

When asked about oral diseases, 80.4% of students reported that they had heard about such diseases. and 79.1% believed that oral diseases can be prevented. This indicates that students have been exposed to and possess a

certain level of knowledge about oral health. This is a positive sign, reflecting the effectiveness of school-based health education programs, parental attention, and the dissemination of information through mass media regarding oral health care.

However, students' knowledge of the signs of dental caries in our study was still limited. The most commonly recognized sign was sensitivity or pain when consuming hot or cold foods and drinks, reported by 70.9% of students. This is a common and easily perceived symptom because when dental caries progress and the cavity reach the dentin, it causes noticeable sensitivity. The fact that many students recognized this sign suggests that they tend to pay attention mainly to obvious and uncomfortable symptoms.

Information about proper toothbrushing techniques and appropriate timing is delivered through multiple channels such as families, schools, and mass media. Nevertheless, among the students surveyed, the level of knowledge about correct toothbrushing was quite limited. The overall proportion of students with correct knowledge across schools was mostly around 45%. The highest awareness rates were for brushing at least twice a day (61.1%) and brushing after waking up (55.8%). The overall mean score was 3.01 out of 6, indicating that only about 50% of the answers were correct.

To assess students' practices in preventing oral diseases in general and dental caries and gingivitis in particular, we evaluated practical behaviors using a pre-designed assessment tool rather than directly observing students' actions. The study results showed that across 14 items related to oral hygiene practices at home and at school, the proportion of students who practiced correctly or performed these behaviors daily was still low. The highest rates were the use of children's toothpaste (85.9%) and the use of children's toothbrushes (79.3%). In contrast, other behaviors and habits were inconsistent and had relatively low implementation rates, indicating limited self-awareness among students. For example, only 46.9% rinsed their mouths after meals, 45.8% brushed all three surfaces of the teeth, and only 44.5% brushed their teeth at least twice a day. Brushing all three tooth surfaces is particularly difficult for children without specific and regular guidance, which helps explain the low rate. Additionally, the proportion of

students who were instructed and reminded by their parents about oral hygiene ranged from only 62.9% to 63.2%

#### **4.2. Effectiveness of selected multimodal intervention measures in improving knowledge and practices and reducing the prevalence of dental caries and gingivitis among students**

Two schools were selected for Phase 2 (the intervention phase): Dong Quang School as the intervention school and Dong Thanh School as the control school. In both the intervention and control schools, the number of students remained unchanged compared with Phase 1 (the pre-intervention survey). The intervention school included 295 students, while the control school included 269 students. After implementing the study's intervention measures over a 12-month period, based on the contents proposed by the project, we obtained results that are analyzed and discussed in the following sections:

##### ***4.2.1. Effectiveness in reducing the prevalence of dental caries and gingivitis among students***

Our study results demonstrate a clear effect in reducing the prevalence of deciduous tooth caries at the intervention school compared with the pre-intervention period. Specifically, the prevalence decreased from 64.4% to 45.1%, with a statistically significant difference ( $p < 0.05$ ). At the control school, the prevalence decreased from 65.4% to 59.9%; however, this difference was not statistically significant ( $p > 0.05$ ). The intervention effectiveness reached 21.6%. The effectiveness in reducing the prevalence of permanent tooth caries was also observed, although the intervention effectiveness reached only 6.8%. At the intervention school, the prevalence decreased from 45.4% to 36.6%, while at the control school it decreased from 46.8% to 40.9%. After the intervention, there was no statistically significant difference in this prevalence at the intervention school ( $p > 0.05$ ). This finding is consistent with the nature of permanent tooth caries, as permanent teeth do not undergo replacement.

Prolonged gingivitis in children not only causes discomfort but can also lead to numerous oral and systemic health complications if not treated promptly. Reducing gingival inflammation improves chewing ability, as gingivitis makes children reluctant to chew, leading to poor appetite. When

inflammation decreases. children can eat more comfortably and absorb nutrients more effectively. It also helps reduce halitosis. supports proper eruption and positioning of permanent teeth, and improves children's cooperation with oral hygiene practices when gingival pain is relieved.

Our study results showed a marked reduction in the prevalence of gingivitis following the intervention. At the intervention school, gingivitis affecting deciduous teeth decreased substantially, with an intervention effectiveness of 35.5%, while gingivitis in permanent teeth showed an intervention effectiveness of 39.0%. Overall, the findings demonstrate that the intervention program was highly effective in reducing gingivitis among students, particularly at the school where the intervention was implemented.

#### ***4.2.2. Effectiveness in changing students' knowledge and practices in disease prevention***

Age-appropriate health education programs require continuous strengthening of knowledge, cognitive and behavioral skills, as well as motivational counseling. Such programs can be applied by dental practitioners in clinical settings or in oral health care more broadly. Successful implementation also requires the active involvement of families and schools. along with the commitment and serious participation of each student. in order to achieve the desired outcomes. The results of our study show that students' correct knowledge about the causes of dental caries improved markedly after the intervention compared with the pre-intervention period. The difference between the intervention school and the control school was statistically significant ( $p < 0.05$ ). The intervention effectiveness ranged from 34.8% to 47.5%. Students' knowledge about the causes of gingivitis also showed a clear improvement before and after the intervention, with the highest intervention effectiveness reaching 49.4%. Notably, 98.6% of students at the intervention school recognized that poor oral hygiene can be a cause of gingivitis and other oral diseases.

Providing children with good knowledge about disease prevention helps reduce the burden of oral diseases in the community and. at the same time, lowers future treatment costs. Therefore, equipping students with accurate and comprehensive knowledge not only helps prevent dental caries

effectively at the individual level but also plays an important role in strategies to improve community oral health in the future.

Our study results also showed that the proportion of students with correct knowledge about the harmful effects of dental caries increased after the intervention compared with the pre-intervention period. In the intervention group, this increase was statistically significant ( $p < 0.05$ ), with the highest intervention effectiveness reaching 47.8%. The intervention effectiveness for students' knowledge of dental caries prevention ranged from 32.4% to 50.5%. Notably, up to 99.3% of students at the intervention school reported that limiting the consumption of sugary foods can help prevent dental caries, with a statistically significant difference ( $p < 0.05$ ).

Regarding students' oral hygiene practices after the intervention, our study results showed many marked improvements. The use of children's toothpaste and toothbrushes reached 100%; 97.6% of students brushed their teeth before going to bed, and 98.3% brushed their teeth after waking up. The highest intervention effectiveness reached 55.2%, with statistically significant differences ( $p < 0.05$ ). The results also indicated strong involvement from parents: 100% of parents guided their children in toothbrushing, and 91.8% regularly reminded their children to maintain oral hygiene at the intervention school. This demonstrates very active parental participation at the intervention school. In contrast, at the control school, these proportions were only slightly above 60%. Changes in dietary habits were also observed: only 45.1% of students occasionally consumed sweets, candy, or soft drinks, and only 29.1% of students still consumed foods that were excessively hot or cold.

## CONCLUSION

### **1. Current status of dental caries, gingivitis, and students' knowledge and practices in disease prevention**

The prevalence of dental caries remained high, with deciduous tooth caries and permanent tooth caries accounting for 65.1% and 47.1%, respectively. The prevalence of deciduous tooth caries was highest among Grade 1 students (73.8%), while the prevalence of permanent tooth caries was highest in Grade 2 (54.2%).

The prevalence of gingivitis was also high, reaching 63.6% in deciduous teeth and 50.9% in permanent teeth. The highest prevalence of gingivitis was observed in Grade 1 students (73.4% in deciduous teeth and 64.8% in permanent teeth). The prevalence of gingivitis was 83.4% among male students and 85.8% among female students.

Students' knowledge about the causes of dental caries was still limited; the most commonly identified cause was hard foods, reported by 61.7% of students. The mean knowledge score was 2.45 out of 4.

Knowledge of the signs of dental caries was also limited, with the most frequently recognized sign being sensitivity or pain when consuming hot or cold foods and drinks (70.9%). The average score for students' knowledge of the harmful effects of dental caries reached only 2.37 out of 4 points. Overall, only 40.5% of students had correct knowledge about the prevention of dental caries and gingivitis.

Daily oral hygiene practices were carried out at low rates. The lowest rate was brushing teeth at least twice a day (44.5%), followed by rinsing the mouth after meals (46.9%), brushing teeth after waking up (62.8%), using a children's toothbrush (79.3%), and using children's toothpaste (85.9%). The proportion of students who practiced correct behaviors for the prevention of dental caries and gingivitis was 37.8%.

### **2. Effectiveness of selected intervention measures in reducing dental caries and gingivitis and improving students' knowledge and practices in disease prevention**

After the intervention, at the intervention school, the prevalence of deciduous tooth caries among students decreased markedly (from 64.4% to 45.1%), with a statistically significant difference ( $p < 0.05$ ); the intervention effectiveness (IE) reached 21.6%. The prevalence of permanent tooth caries decreased from 45.4% to 23.7%. The overall prevalence of dental caries decreased from 80.3% to 49.8%, with  $p < 0.05$ .

After the intervention, at the intervention school, the prevalence of gingivitis in deciduous teeth decreased from 60.0% to 32.9% ( $p < 0.05$ ), with an intervention effectiveness (IE) of 35.5%. The prevalence of gingivitis in permanent teeth decreased from 64.8% to 31.1% ( $p < 0.01$ ), with an IE of 39.0%.

Students' knowledge about oral disease prevention increased markedly. The IE for knowledge of the causes of dental caries after the intervention reached a maximum of 47.5%, while the IE for knowledge of dental caries prevention ranged from 32.4% to 50.5%.

Students' oral disease prevention practices also improved substantially. The use of children's toothpaste and toothbrushes was reported by 100% of students; 97.6% brushed their teeth before bedtime, and 98.3% brushed their teeth after waking up. The highest IE reached 54.7% ( $p < 0.05$ ). Overall, the IE for knowledge reached 81%, and for practice reached 74.9%.

## RECOMMENDATIONS

### 1. Local health and education authorities

Parents should work together with schools in disseminating knowledge, encouraging, and guiding primary school-aged children in the prevention of oral diseases in general, and dental caries and gingivitis in particular.

### 2. Schools and school health services

- It is necessary to strengthen communication and health education activities on oral hygiene for students at schools, including integrating knowledge on oral disease prevention into extracurricular activities.

- Organize screening examinations, guidance, and counseling for students showing signs of dental caries or gingivitis, and promptly refer them for examination, treatment, and early, appropriate, and scientific self-care of oral health.

### 3. Parents and primary school students

- Parents need to enhance their role and responsibility in caring for their children's oral health by regularly guiding and supervising children to correctly perform daily oral hygiene practices, such as proper toothbrushing, using fluoride toothpaste, and limiting the consumption of sugary foods in the evening.

- Actively take children for regular dental check-ups and seek timely treatment when abnormal signs are detected.