

## The Prevalence of Dental Caries, Associated Factors and Treatment Needs in Children Up to Age 12 at Dental Hospital in Phitsanulok, Thailand

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### Abstract

The purpose of this retrospective study is to investigate the prevalence of dental caries in children age 0.5-12 years at Naresuan University Dental Hospital during 2017-2019, the variables associated with occurrence of those caries, and the frequency of treatments applied. A study was performed by collecting from each patient's record the total number of decayed, missing, or filled primary and permanent teeth; the types of clinical caries and the number of each type; treatment needs; and various factors that could potentially affect the development of caries. The research team was trained by the principle investigator, and data collection criteria were uniformly standardized. The relationships between the factors that could affect caries and the actual caries experience were statistical analyzed using the chi-square and odds ratio methods. The overall prevalence of dental caries among the 300 patients sampled was 95.33 % , so only 4.67 % of the patients had never had caries. The average dmft and DMFT were 8.49 and 0.74, respectively. The statistical analysis revealed a significant correlation between the frequency of tooth brushing and the mean combined dmft+DMFT, with  $p = 0.003$ . Children who either brushed their teeth only once a day or did not brush at all had a higher mean combined dmft+DMFT value than children who brushed their teeth twice a day (OR = 4.738, 95% CI = 1.292-17.376). Other variables did not show any statistical relationship with the mean combined dmft+DMFT.

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### Introduction

Dental caries are an important health issue that afflict virtually every person in the world <sup>1</sup>. Prevalence of dental caries in primary and permanent dentition of children age 1-14 years from 74 countries was 8.8 % and 35.4 %, respectively, as of 2010 <sup>2</sup>. In Thailand specifically, the prevalence of dental caries in primary and permanent dentition of children age 5 years and age 12 years is much higher than the global dental caries prevalence for ages 0 – 14, which is 52.9 % and 52.0 %, respectively <sup>3</sup>. Even though nationwide survey data exists on dental caries prevalence in Thailand as a whole, different

areas in the country vary in their local environment, culture, average income levels, and other similar factors which can greatly influence the susceptibility of a child to caries. The nationwide survey also usually has some inherent limitations resulting from uncontrolled variables such as the difficulty standardizing oral examinations, lack of radiographic data, or inadequate lighting at the examination location. On the other hand, employing a carefully designed, standardized examination and recording protocol to assess and document dental caries prevalence in each specific area can shine a spotlight and illuminate in detail what is happening in that particular area's population and thereby provide useful information for meeting the real-life oral health needs of that population.

In 2013, the dental caries prevalence in primary and permanent dentition of children in Phitsanulok Province, Thailand, were respectively 58.48 % and 52.41 %, but by 2016, these two figures had dropped to 48.67 % and

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46.70 %, respectively. Although the caries prevalence in Phitsanulok children appeared to decline from 2013 to 2016, the latter figure is still higher than the dental caries prevalence typically found in developed countries. Also the existing available data lacks information on what factors are associated with caries and what kind of treatment these children require.

The purpose of this study is to investigate the dental caries prevalence and treatment needs of children seen at Naresuan University Dental Hospital in Phitsanulok in 2017-2019 and to identify variables associated with experience of caries.

### Materials and methods

This retrospective study was carried out with approval from the Naresuan University Research Ethics Committee. The minimum required sample size was calculated using the basic formula  $n = Z^2Pq/d^2$ , where  $Z = 1.96$ ,  $p$  (prevalence of caries from previous studies) = 48.67 %,  $q = 1 - P$ , and  $d$  (precision level) = 0.05<sup>4</sup>. Thus the minimum required sample size was 261. The sample size in this study was 300 patients.

Data was collected from records of Naresuan University Dental Hospital patients age 0.5-12 years who received a complete dental exam and a treatment plan during the period 2017-2019. Record files of 300 patients meeting these criteria were selected from the dental hospital's database using systematic sampling. The research team was trained by the principle investigator (PI), and data collection criteria were uniformly standardized. The four researchers collected the following information once for each patient, based on the patient's initial visit and examination, when treatment was prescribed: Patient demographic data, dmft, DMFT, dental caries type(s) (cavitated, arrested, active, or inactive lesion), dental treatment needs (fluoride varnish, sealant, filling, extraction, pulp treatment, crown, or space maintainer), and caries associated factors (from the caries risk assessment form).

In order to ensure the reliability of data collection, two calibrations were performed and passed prior to commencement of the study: both intra-researcher and inter-researcher calibrations. In the intra-researcher calibration, each researcher collected data from 20 random records and then, following a mandatory 48-hour

waiting period, collected data from the same 20 records a second time. The two data collection results were then later compared. In the inter-researcher calibration, each researcher collected data from 20 random records a single time. Then each researcher's work was reviewed by the PI and checked for accuracy against the correct responses. Inter-researcher reliability was assured by requiring every researcher to achieve a kappa value in excess of 0.80 before the study began.

After the data collection for the study was complete, every patient record was examined by the research team and PI to identify any existing inconsistencies in researcher data collection. Any mismatched data was discussed between all the researchers and the PI to reach a consensus before data analysis.

Data was processed and analyzed using the Statistical Package of the Social Sciences (Version 17, SPSS Inc., USA). Descriptive statistics including mean, standard deviation, frequency, percentage, and prevalence were calculated. The chi-square test was used to test the correlation between caries associated factors and caries experience. An odds ratio with a 95 % confidence interval was applied to assess the strength of the association. The level of significance was set at 0.05.

### Results

#### Demographic data

This study analyzed dental records of a total of 300 children who were patients at Naresuan University Dental Hospital. Table 1 shows the demographic data of this study population. There were 178 boys (59.3 %) and 122 girls (40.7 %), age 0.5 to 12 years old. Most of the children were of normal weight and height.

#### Caries experience

Table 2 summarizes the caries experience of the 300 children in the study. Dental caries prevalence in the total population was 95.33 %, and the number of children without any caries was 4.67 %. Caries prevalence in primary dentition (90 %) was higher than that in permanent dentition (26.72 %).

Figure 1 shows the patients' caries experience broken down into primary dentition (dmft) and permanent dentition (DMFT), as distributed by patient age. Caries experience in both dentitions was found to increase as age

increased. The average dmft and DMFT in the study population were 8.49 and 0.74, respectively.

Variables	N	%
<b>Age (years)</b>		
0.5-2	53	17.70
3-5	99	33.00
6-9	118	39.30
10-12	30	10.00
<b>Total</b>	<b>300</b>	<b>100.00</b>
<b>Gender</b>		
Boy	178	59.30
Girl	122	40.70
<b>Weight</b>		
Overweight	40	13.30
Normal weight	227	75.50
Underweight	27	9.00
No data	6	2.00
<b>Height</b>		
Tall	44	14.70
Average	234	78.00
Short	16	5.30
No data	6	2.00

**Table 1.** Demographic data of the study population, with weight and height designations as defined by Thailand's Ministry of Health.

Age (years)	N	Primary teeth				Permanent teeth				Total			
		dt = 0		dt > 0		DT = 0		DT > 0		No Caries		Caries > 0	
		N	%	N	%	N	%	N	%	N	%	N	%
0.5-2	53	6	11.32	47	88.68	-	-	-	-	6	11.32	47	88.68
3-5	99	3	3.03	96	96.97	97	97.98	2	2.02	3	3.03	96	96.97
6-9	118	7	5.93	111	94.07	74	62.71	44	37.29	3	3.39	114	96.61
10-12	30	14	46.67	16	53.33	10	33.33	20	66.66	1	0.85	29	96.67
<b>Total</b>	<b>300</b>	<b>30</b>	<b>10.00</b>	<b>270</b>	<b>90.00</b>	<b>181</b>	<b>73.28</b>	<b>66</b>	<b>26.72</b>	<b>14</b>	<b>4.67</b>	<b>286</b>	<b>95.33</b>

**Table 2.** Overview of caries experience by patient age.  
 dt = primary decayed tooth, DT = permanent decayed tooth.

This study categorizes caries into four types: initial caries, arrested caries, cavitated caries, and retained root. The types of dental caries in this study population are shown in Table 3.

The most frequent caries type in primary dentition was cavitated caries, followed by initial caries. Children age 6-9 had more cavitated primary dental caries than any other age group. On the other hand, the most frequent caries type in permanent dentition was initial caries, followed by cavitated caries. Occurrence of both these types of permanent dental caries was highest in children 10-12.

Dentition	Initial caries		Arrested caries		Cavitated caries		Retained roots	
	%	Mean dmft ± SD	%	Mean dmft ± SD	%	Mean dmft ± SD	%	Mean dmft ± SD
<b>Primary teeth</b>								
0.5-2 years	58.49	1.47 (1.8)	11.32	0.25 (0.8)	67.92	4.89 (5.0)	13.20	0.43 (1.2)
3-5 years	57.58	1.60 (1.9)	44.44	1.59 (2.4)	89.90	6.57 (4.2)	25.25	0.79 (1.6)
6-9 years	53.39	1.30 (1.7)	29.66	0.80 (1.6)	94.07	4.09 (3.4)	25.42	0.58 (1.4)
10-12 years	16.67	0.42 (0.8)	6.67	0.21 (0.7)	50.00	2.79 (2.3)	10.00	0.21 (0.5)
<b>Total</b>	<b>54.55</b>	<b>1.37 (1.8)</b>	<b>30.42</b>	<b>0.93 (1.8)</b>	<b>84.27</b>	<b>5.01 (4.1)</b>	<b>22.73</b>	<b>0.60 (1.4)</b>
<b>Permanent teeth</b>								
3-5 years	1.01	0.04 (0.2)	0	0	1.01	0.08 (0.4)	0	0
6-9 years	25.42	0.55 (1.2)	4.44	0.10 (0.5)	14.41	0.25 (0.7)	0	0
10-12 years	46.67	1.43 (2.1)	13.33	0.37 (1.0)	33.33	0.83 (1.8)	0	0
<b>Total</b>	<b>26.63</b>	<b>0.63 (1.4)</b>	<b>5.33</b>	<b>0.13 (0.6)</b>	<b>16.57</b>	<b>0.33 (1.0)</b>	<b>0</b>	<b>0</b>

**Table 3.** Types of dental caries in the study population.

Dentition	Dental treatment needs						
	Fluoride varnish*	Sealant*	Filling	Crown	Pulp treatment	Extraction	Space maintainer
<b>Primary teeth</b>							
0.5-2 years	58.49	9.09	60.37	39.62	35.85	18.87	1.89
3-5 years	54.55	23.23	86.87	45.45	59.60	50.51	12.12
6-9 years	44.92	22.22	79.66	24.58	38.14	49.15	13.56
10-12 years	20.00	6.67	23.33	16.67	6.67	26.67	0
<b>Permanent teeth</b>							
6-9 years	6.78	22.03	15.25	0	2.54	0	0
10-12 years	20.00	33.33	30.00	0	10.00	6.67	0

**Table 4.** Prevalence of different types of dental treatment needs.

\*Fluoride varnish and sealant were counted here when used for caries treatment, but not when used for prevention.

This study surveyed the dental treatment needs in patients as presented in the treatment plan from each patient's record. Table 4 shows the prevalence of the different types of dental treatment needs. Fluoride varnish or sealant that

was used as the treatment option for non-cavitated initial caries was counted for the purposes of the survey. However fluoride varnish or sealant that was used in a prevention phase was not included. The highest prevalence among dental treatment needs for primary teeth was extraction, followed by filling, fluoride varnish, crown, sealant, and pulp treatment. For permanent teeth, the children needed sealant the most, followed by filling, fluoride varnish, pulp treatment, and extraction.

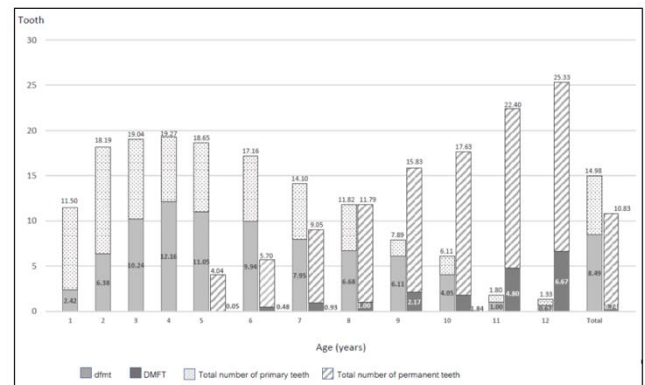
Variables	N (%)	Caries experience		
		Mean dmft+DMFT (± SD)	Chi-square	p-value
<b>1. Systemic disease/ Syndrome</b>				
Yes	9	11.22 (5.8)	0.35	0.552
No	291	9.17 (5.2)		
<b>2. Frequency of tooth brushing</b>				
None / once a day	28	9.44 (6.8)	11.42	0.003*
Twice a day	206	9.17 (5.0)		
≥ 3 times a day	65	9.42 (5.0)		
<b>3. Tooth brushing with fluoride toothpaste</b>				
Yes	92	8.45 (5.2)	0.71	0.400
No	52	9.06 (5.8)		
<b>4. Number of times snacking between meals per day</b>				
> 2 times per day	100	9.42 (5.7)	0.50	0.481
≤ 2 times per day	58	8.29 (4.8)		
<b>5. Wearing space maintainer or appliance</b>				
Yes	5	7.00 (3.5)	0.19	0.660
No	295	9.27 (5.2)		
<b>6. Plaque index (Modified oral hygiene index<sup>15</sup>)</b>				
very poor	92	9.96 (4.8)	2.65	0.267
poor	30	6.90 (5.0)		
fairly	9	7.78 (4.3)		
<b>7. Weight</b>				
Overweight	40	7.85 (5.3)	3.07	0.216
Normal weight	227	9.51 (5.1)		
Underweight	27	10.15 (5.2)		
<b>8. Height</b>				
Tall	44	8.61 (5.8)	2.25	0.325
Normal	234	9.31 (5.0)		
Short	16	11.75 (5.3)		
<b>9. Gender</b>				
Boy	178	8.90 (5.1)	0.11	0.742
Girl	122	9.71 (5.4)		

**Table 5.** Association between dental caries experience and related factors.

dmfs = decayed, missing, and filled surfaces of primary teeth  
 DMFT = decayed, missing, and filled surfaces of permanent teeth  
 \*Statistical significance with chi-square test ( $p < 0.05$ ).

Variable	Mean dmft+DMFT	Odds ratio	95% Confidence Interval
<b>Frequency of tooth brushing</b>			
1. None / once a day	9.44	4.738	1.292-17.376
2. Twice a day	9.17		
3. ≥ 3 times a day	9.42		

**Table 6.** Odds ratio of caries associated factors and caries experience.



**Figure 1.** Caries experience broken down into dmft and DMFT, as distributed by patient age.

Analysis of the relationship between caries experience (dmft+DMFT score) and caries associated variables is shown in Table 5. The frequency of toothbrushing was significantly associated with caries experience ( $p=0.003$ ). The children who brushed their teeth two times per day had fewer caries than the children who never brushed their teeth or brushed only once a day. The odds ratio analysis, shown in Table 6, indicates that someone who brushed their teeth only once a day or did not brush at all had on average 4.738 times more caries than someone who brushed their teeth twice a day.

## Discussion

This study categorized 300 Thai children subjects according to the tooth dentition into 4 groups; 0.5-2 years, an early primary dentition; 3-5 years, late primary dentition; 6-9 years, early mixed dentition; and 10-12 years, late mixed dentition. The results showed very few caries-free children (4.67 %) from the total population. The prevalence of caries-free subjects in this survey is also less than the prevalence from the national oral health survey in 2017 (24.4 - 47.1 %) <sup>3</sup>. This may be because in this study, we collected all kinds of carious teeth which included clinical and radiographic ones. Proximal carious lesions without marginal ridge breakdowns cannot be detected by a clinical examination only. Bitewing radiographs were required to detect non-cavitated proximal carious lesions in closed contact dentition. Moreover, dental examinations in dental schools usually provide precise dental diagnosis and treatment plans compared to the field surveys<sup>5</sup>. This study showed an increase of dental caries in primary teeth as the children got

older, and 96.67 % of the 3-5 years old age group had carious lesions. When the children were aged 6-9 during early mixed dentition, they usually had some exfoliation of anterior primary teeth which caused a decrease in the prevalence of dental caries in this age group by 94.07 %. In permanent dentition, the older the child, the higher the prevalence of caries as well as the average DMFT score. This implies that high caries experience in primary dentition may have some implications that leads to increasing the caries experience in permanent dentition<sup>6</sup>. Skeie and colleagues reported that primary second molars with multi-surface caries in 5 year olds was a high risk clinical predictor for dental caries at age 10<sup>7</sup>. Caries associated factors in young children with high carious teeth, may remain or continue to be affected and create an oral environment for new erupted permanent teeth becoming more susceptible to caries.

In this study, in terms of the caries types, the cavitated ones were the highest in primary teeth, followed by the initial and arrested caries, and retained roots, respectively. This result is inconsistent with the study by Autio-Gold, et al. in 2005 which showed the average number of active noncavitated enamel caries of children aged 5 in the USA, was slightly higher than those of cavitated dentinal lesions. The highest caries type in permanent teeth from this study is initial caries, followed by cavitated and arrested ones. The high number of cavitated caries in primary teeth and the high number of initial caries in permanent teeth of Thai children, may imply a susceptibility of this condition which is consistent for all age groups. These results reflect a severe risk of caries for Thai children, therefore, the prevention and treatment strategies which have been used all over the nation, need to be re-evaluated.

The data of dental treatment needs in this study, found that fillings were the most urgent treatment required in primary dentition except for the 10-12 year olds that needed more extractions. These results showed that when the younger groups primary teeth had untreated cavitated caries, it progressed to the loss of the tooth as they got older, leaving only the roots, while a high number of permanent teeth with initial caries, require sealant treatment. In Thailand, there is a dental public health policy to seal every first permanent molars for grade 1 students. Sealant is known as an effective prevention of pit and

fissure caries, and also prevents the progression of initial caries on occlusal surfaces<sup>8</sup>. The initial caries condition and treatment needs for sealing permanent teeth in this study reflect the high rate of dislodged sealant on children's teeth. When this problem is observed, there is an opportunity to stop the process of caries before becoming cavitations. The government sealant program should be expanded to cover more primary school-aged children, and the training program for effective performance should also be considered, as well as the follow up program for the resealing of teeth.

From this study, the correlation between caries associated factors and caries experience in children, showed that the frequency of toothbrushing was significantly related to the caries experience score. The children who brushed their teeth twice a day, were 4.73 times more likely to have a low caries score than those that never brushed or brushed only once a day ( $p=0.003$ ). There was no correlation between caries experience and other factors (systemic disease/syndrome, toothbrushing with fluoride toothpaste, number of times of snacking between meals per day, wearing space maintainers or appliances, plaque index, weight, height and gender). This was consistent with the findings of other studies that examined caries related factors in children<sup>9-12</sup>. The available patient records did not provide all the risk factor data which is known as the limitation of retrospective study, that does not mean the frequency of brushing teeth is the only correlated factor to the susceptibility of caries. There are more other caries risk factors which were not evaluated in this study, but were shown to be related to increments of dental caries in children<sup>13,14</sup>.

The prevalence of dental caries in 0.5-12 year old children in Phitsanulok, was higher than those from the nationwide survey. Every age group showed a high caries score of primary teeth. The amount of fillings required directly reflected the severity of the caries status which was mainly for cavitation. In permanent dentition, the prevalence of caries experience was also high and the required treatment was sealant to inhibit the initial caries. Therefore, the current nation-wide preventive program is not sufficient enough to address this problem. The sealant program needs to be emphasized and implemented for 6-9 year old children in this area, as well as follow up programs to make sure that it

has remained intact or requires resealing, and at the same time, other prevention strategies should be implemented especially the frequency of brushing teeth. This study found that brushing teeth twice a day helps to reduced dental caries in children when compare to brushing once a day or less. Future research should be a prospective study which accumulates the dental caries prevalence as well as associated caries factors that could not be retrieved from this study, such as economic status, parental factors, eating habits, fluoride exposure, and barriers.

### Conclusions

In this study the dental caries prevalence in children aged 0.5-12 years old in Phitsanulok, Thailand, was 95.33 %, while the highest prevalence of caries at 96.97% in primay teeth was found in the 3-5 year aged group. Almost all of the childrens dental carious primary teeth required fillings. In permanent dentition, the most frequently found caries was initial caries, which required treatment by using sealant. Children who brushed their teeth once a day or not at all, had significantly higher caries experiences than the children who brushed twice a day, by 4.73 times.

### Declaration of Interest

The authors report no conflict of interest.

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