

Assessment of Caries by Using FDI Caries Matrix among Preschool Children in Muang District, Nakhonsawan

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Abstract Dental caries, one of the most widespread diseases, has traditionally been assessed by WHO criteria including only obvious caries lesion. Some more indices were established to detect wider range of caries including FDI caries matrix. The purpose of this study was to provide an assessment of caries as a health outcome. A total number of 563 kindergarten students in the age group of four to six years were examined from 3 purposively selected primary schools in municipal area of Muang District, Nakhonsawan. Diagnosis was visual with drying of the teeth by gauze and careful examined by plain mouth mirror under natural light. The intra examiner agreement in diagnosis was determined by Kappa coefficient (0.77). Descriptive statistics, chi square and ANOVA were used to analyze the data at the statistical significance level of $p < 0.05$. The prevalence of caries and untreated caries (pufa>0) of the preschool students aged 4, 5 and 6 were 78.2, 89.8, 94.1 and 44.9, 59.6 and 74.1 respectively. The mean numbers of pufa were 1.78 ± 2.70 , 3.03 ± 3.72 and 4.18 ± 3.89 respectively. Not only the prevalence of caries and untreated caries (pufa>0) but also mean numbers of pufa were statistically significant associated with age. FDI caries matrix seemed to give much more relevant information about caries progression which could provide appropriate caries-preventive intervention.

Key words: caries assessment, FDI caries matrix, preschool children

Introduction

Caries is one of the most widespread diseases in the world. The Decayed Missed and Filled Surfaces/Teeth (DMF/dmf) index has been in use and is well established as the leading measure of caries experience in dental epidemiology. Capital letters are used for permanent dentition, small letters for primary teeth.⁽¹⁻²⁾ During the last decade, DMF/dmf the clas-

restorative and surgical treatment came in for criticism to be a not enough valid tool to diagnose all stages of caries.⁽³⁻⁵⁾ For detecting the wider range of caries lesions, some more indices were established such as the International Caries Detection and Assessment System (ICDAS),⁽⁶⁾ Classification System and Caries Assessment Spectrum and Treatment Index (CAST)⁽³⁾ and PUFA/pufa index.⁽⁷⁾ ICDAS is a peer-reviewed and internationally recognized clinical scoring system

designed to lead to better-quality information and to provide a framework to support and enable personalized total caries management for improved long-term health outcomes. CAST is a comprehensive and pragmatic hierarchical caries assessment index describing the complete range of stages of caries progression. PUFA/pufa index to measure and record the consequences of caries disease process at its most severe and advanced stages provides the opportunity to supplement direct caries measures with quantification of the consequences of caries and to communicate the effect of oral disease. ICDAS and CAST are widely used as part of practice-based caries management for patients mostly in developed countries. The PUFA/pufa index, P/p denotes the pulpal involvement, U/u – the ulceration of soft tissues, F/f refers to the presence of an odontogenic fistula, and A/a denotes an abscess, finds a particular application in populations with a high incidence of dental caries.

Dental caries classification is based on different criteria such as treatment of choice, morphology, prior condition of the tooth, severity and rates of caries progression, extent of the lesion, chronology, etiology and affected tissues. The indices have strengths, potential gaps and deficiencies. Caries lesion classification should shift from a system that predominately describes the current state of a lesion that needs to be restored to a system that assesses and quantifies the risk of progression of the disease. Whereas caries as a disease is largely preventable, from a management perspective it involves many factors that influence health outcomes at both an individual and a population level. In 2012, the FDI Science Committee developed the FDI Caries Matrix,⁽⁸⁻⁹⁾ (Table 1). The intent of this matrix as not to establish a new caries

lesion classification system, but to integrate existing systems into a framework that could be used by clinicians, researchers, educators, public health workers and decision makers.

The objective of this study was to assess dental caries as a health outcome among preschool children in Muang District, Nakhonsawan by using FDI caries matrix.

Materials and Methods

The study was conducted within the period from June to July 2014 which was the period of routine oral health surveillance program in primary school. The samples consisted of 563 kindergarten students (314 males and 249 females) were examined from 3 purposively selected primary schools in municipal area of Muang District, Nakhonsawan (1 private and 2 public schools). The samples were divided into three groups according to age as follows: group 1: 4 years old (n=243); group 2: 5 years old (n=235); and group 3: 6 years old (n =85).

Clinical examination was carried out routinely in the classroom of each school under natural daylight. Each student was examined semi-supine by the researcher and data recorded by a trained assistant. Diagnosis was visual with drying of the teeth by gauze and careful examined by plain mouth mirror under natural light. The codes and criteria for FDI caries matrix are as follows (Figures 1 and 2)

10% of the studied group was re-examined. The intra examiner agreement in diagnosis determined by Kappa coefficient showed a good level of reliability at 0.77. The obtained data was statistically analyzed using descriptive statistics, chi square and ANOVA.

Table 1 FDI Caries Matrix under development by FDI Science Committee

Level 1 - Corresponds to D_3MFT/D_3MFS (that is, WHO basic methods)	I = Sound No obvious dentin caries				II = Decayed Obvious dentin caries	PUFA	M	F		
	Level 2 - Corresponds to but does not accurately represent D_1MFT threshold/ADA system/ collapsed ICDAS detection codes and others	0 Sound	a +/- Noncavitated enamel	b +/- Cavitated enamel	c +/- Non cavitated dentine	d +/- Frank open cavity	PUFA	M	F	
Level 3 - Corresponds to full ICDAS 1-6 detection codes	0 Sound	1 +/- Non- cavitated enamel (first visual change in enamel)	2 +/- Non- cavitated enamel (distinct visual change in enamel)	3 +/- Cavitated enamel (localized enamel breakdown)	4 +/- Non- cavitated dentin (underlying dentin shadow)	5 +/- Frank open cavity (distinct cavity with visible dentin)	6 +/- Frank open cavity (extensive cavity with visible dentin)	PUFA Dental/ odontogenic infection)	M Missing teeth	F Filled teeth

Figure 1 (a) Sound, (b, c) Non-cavitated enamel, (d) Cavitated enamel, (e) Non-cavitated dentin, (f) Frank open cavity

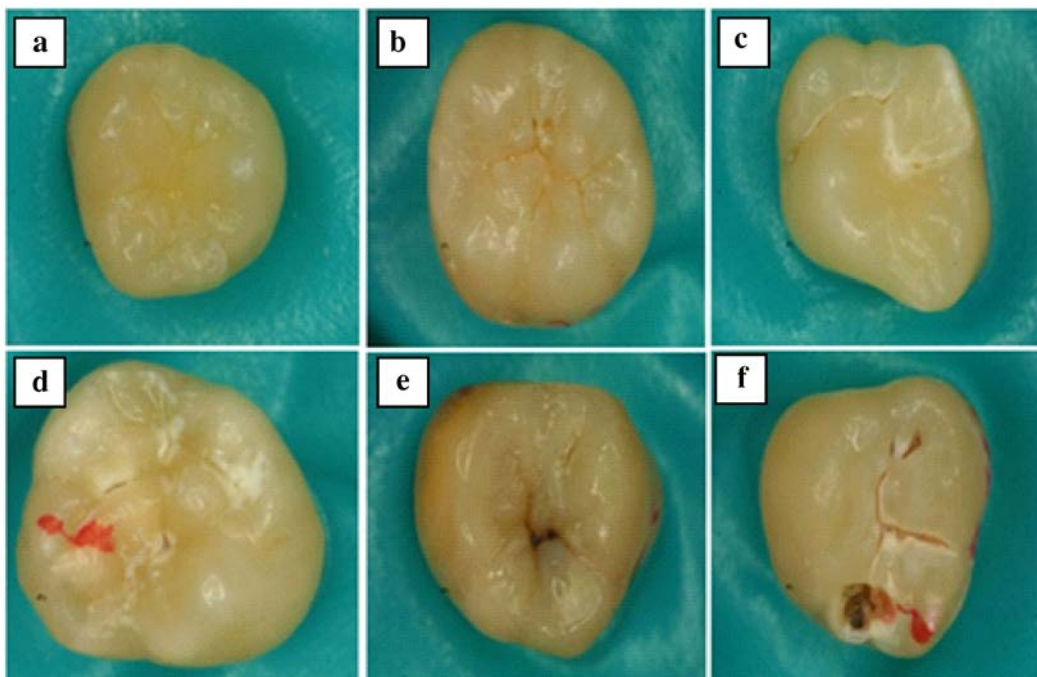


Figure 2 (a, b) Pulpal involvement, (c, d) Ulceration, (e, f) Fistula, (g, h) Abscess

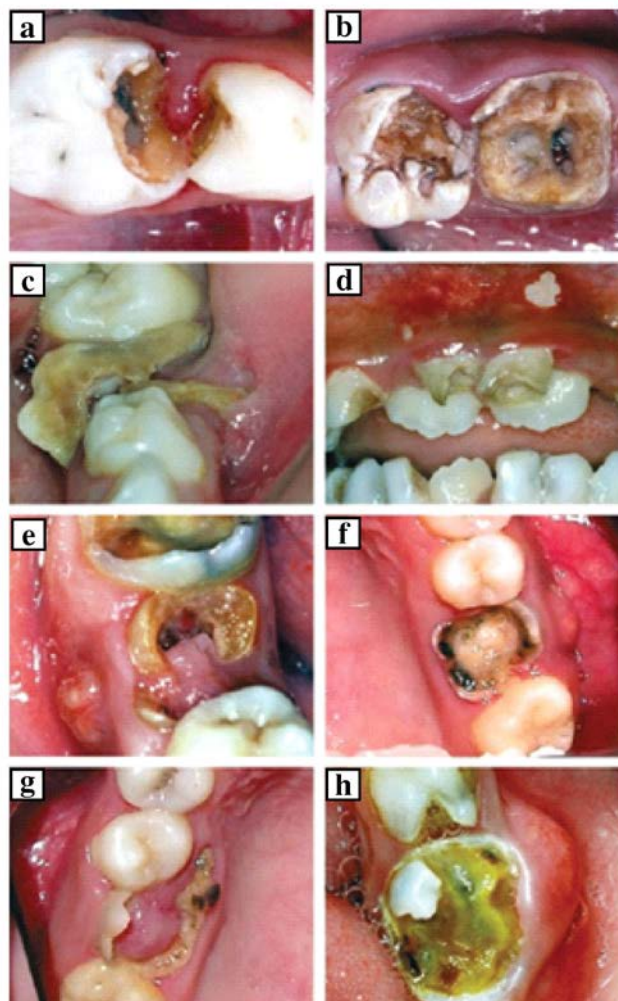


Table 2 The codes and criteria for FDI caries matrix

Code	Criteria
0	Sound (Figure 1a)
a	Noncavitated enamel, white lesion (Figures 1b, 1c)
b	Cavitated enamel (localized enamel breakdown) (Figure 1d)
c	Noncavitated dentin (underlying dentin shadow) (Figure 1e)
d	Frank opening cavity (cavity with visible dentin) (Figure 1f)
p	Pulpal involvement is recorded when opening of the pulp chamber is visible or when the coronal tooth structures have been destroyed by the carious process and only roots or roots fragments are left. No probing is performed to diagnose pulpal involvement (Figures 2a, 2b)
u	Ulceration due to trauma from sharp edges of dislocated tooth with pulpal involvement or root fragments have caused traumatic ulceration of the surrounding soft tissues; e.g., tongue or buccal mucosa (Figures 2c, 2d)
f	Fistula is scored when a pus releasing sinus tract related to a tooth with pulpal involvement is present (Figures 2e, 2f)
a	Abscess is scored when a pus containing swelling related to a tooth with pulpal involvement is present (Figures 2g, 2h)
m	Missing teeth
f	Filled teeth

Results

The sample was distributed according to age and gender as shown in Table 3. The prevalence of caries of the preschool students aged 4, 5 and 6 were 76.1, 86.0 and 90.6 at level 1 and 78.2, 89.8 and 94.1, respectively at level 2. The prevalence of caries was statistically significant associated with age of the preschool students ($p < 0.05$) at both level 1 and 2 (Table 4). In addition, almost a half of group 1 children (44.9%) had at least one tooth with $pufa > 0$, where such scores were observed 59.6% and 74.1% in stud-

ied 5 and 6 years old. The prevalence of $pufa > 0$ was also associated significantly with age of the preschool students at $p < 0.05$ (Table 5).

Table 6 presented the mean values of different extension of caries at both level of information. Caries experienced was the summation of number of decayed, $pufa$, missing and filled teeth in level 1. The mean values of sound, $pufa$, missing, filled and caries experienced teeth were statistically significant difference with age of the studied students (p value < 0.05). For level 2, caries experienced was the summation of

Table 3 Distribution of the sample regarding age groups and gender

Age (years)	male		female		Total	
	n	%	n	%	N	%
4	133	54.7	110	45.3	243	100.0
5	129	54.9	106	45.1	235	100.0
6	52	61.2	33	38.8	85	100.0
Total	314	55.8	249	44.2	563	100.0

Table 4 Prevalence of caries by age regarding level of information

Age	Caries Free		Caries Experienced		χ^2	p value
	n	%	n	%		
Level 1 Corresponds to D_3 MFT ie WHO Basic Methods						
4 years	58	23.9	185	76.1	12.573	0.002*
5 years	33	14.0	202	86.0		
6 years	8	9.4	77	90.6		
Total	99	17.6	464	82.4		
Level 2 Corresponds to D_3 MFT threshold/ADA system/collapsed ICDAS detection codes & others						
4 years	53	21.8	190	78.2	18.979	<0.001*
5 years	24	10.2	211	89.8		
6 years	5	5.9	80	94.1		
Total	82	14.6	481	85.4		

number of non-cavitated and cavitated enamel, non-cavitated dentin, frank opening cavity pufa, missing and filled teeth. Only mean values of cavitated enamel, pufa, missing, and caries experienced teeth were associated with age of the samples (p value<0.05).

Table 5 Prevalence of pufa (dental/odontogenic infection) by age

Age	pufa = 0		pufa > 0		χ^2	p value
	n	%	n	%		
4 years	134	55.1	109	44.9	24.624	<0.001*
5 years	95	40.4	140	59.6		
6 years	22	25.9	63	74.1		
Total	251	44.6	312	74.1		

Table 6 Mean values of caries at different extension regarding level of information

Extent of Caries	4 years Mean±SD	5 years Mean±SD	6 years Mean±SD	Total Mean±SD	F	p value
Level 1 Corresponds to D₃ MFT ie WHO Basic Methods						
sound	14.32±5.03	11.79±5.74	9.99±5.61	12.61±5.65	25.588	<0.001*
decayed	3.58±3.43	3.94±3.12	4.19±3.37	3.82±3.30	1.319	0.268
pufa	1.78±2.70	3.03±3.72	4.18±3.89	2.66±3.45	18.571	<0.001*
missing	0.13±0.57	0.28±0.92	0.38±0.91	0.23±0.79	3.877	0.021*
filled	0.14±0.83	0.43±1.36	0.13±0.69	0.26±1.07	5.198	0.006*
caries experienced ^A	5.64±5.05	7.68±5.62	8.87±5.27	6.97±5.44	15.20	<0.001*
Level 2 Corresponds to D₃ MFT threshold/ADA system/collapsed ICDAS detection codes & others						
sound	12.95±5.77	10.36±6.04	8.69±5.73	11.23±6.08	20.905	<0.001*
noncavitated enamel	0.64±1.22	0.46±0.98	0.44±1.05	0.53±1.10	2.058	0.129
cavitated enamel	0.07±0.44	0.26±0.68	0.22±1.13	0.17±0.69	4.701	0.009*
noncavitated dentin	0.65±1.16	0.72±1.48	0.64±1.33	0.68±1.33	0.195	0.823
frank opening cavity	3.58±4.33	3.94±3.12	4.19±3.37	3.82±3.30	1.319	0.268
pufa	1.78±2.70	3.03±3.72	4.18±3.89	2.66±3.45	18.571	<0.001*
missing	0.13±0.57	0.28±0.92	0.38±0.91	0.23±0.79	3.877	0.021*
filled	0.14±0.83	0.43±1.36	0.13±0.69	0.26±1.07	5.198	0.006*
caries experienced ^B	7.00±5.74	9.11±5.94	10.16±5.35	8.36±5.89	12.903	<0.001*

Remark: ANOVA test

Caries experienced^A includes decayed, pufa, missing and filled teeth

Caries experienced^B includes noncavitated and cavitated enamel caries, noncavitated dentin, frank opening cavity, pufa, missing and filled teeth

Discussion

Normally, children's oral health problems were investigated through the use of clinical measurements, like the dmft index (classical index) established as the key measure of caries experienced in dental epidemiology. The d-component of the WHO classical dmft index included all stage of carious lesions which could not explain the treatment needs of the lesion. But, decayed component at level 1 of the FDI caries matrix was different. Decayed teeth showed treatment needs of fillings but still could not be told the number or which surfaces because the caries matrix does not address surface origin of the caries. Untreated caries leads to pulpal inflammation and in consequence to the formation of periapical abscess. Therefore, it appears to be justified to clinical consequences of untreated caries (pufa). But, pufa is still lack of differentiation between teeth classified for pulpal treatment and those which should be extracted due to an extensive destruction of the tooth crown.

The results obtained from the samples age 4 to 6 revealed that the prevalence of caries (82.4% at level 1 and 85.4% at level 2) and pufa (74.1%) were similarly very high. The treatment of deciduous teeth was quite commonly neglected. The mean numbers of missing (0.23) and filled (0.26) teeth were rather small. High scores regarding decayed (3.82 at level 1) or frank opening cavity (level 2) and pufa (2.66) can be explained by the lack of dental treatment. Quite a number of untreated carious lesions had a rapid progression to pulpal involvement and further complications. Children with untreated caries had a substantial risk of developing pain or having an extraction which could be led to early loss of primary teeth. Premature loss of teeth undoubtedly influences the quality of life

of children and their families.⁽¹⁰⁾

We should pay some more attention on non-cavitated/cavitated enamel and non-cavitated dentin because these lesions might progress to frank open cavity if they did not get any caries-preventive intervention. Sealants are effective in caries prevention and that sealants can prevent the progression of early non-cavitated carious lesion on pit and fissure.⁽¹¹⁾ Fluoride is a key agent in reducing the prevalence of dental caries.⁽¹²⁾ Fluoride vanish and silver diamine fluoride are used by dental profession while fluoride toothpaste and mouth rinse can be self care. As mentioned before, caries matrix does not address surface origin of the caries, non-cavitated/cavitated enamel and non-cavitated dentin caries-preventive intervention can be launched not only by dental profession but also by self care. The scientific literature reinforces the importance of daily tooth brushing with fluoridated toothpaste for preventing dental caries.⁽¹³⁾ Strong evidence exists between the caries-preventive effect of daily use of fluoridated toothpaste and the preventive of dental caries.⁽¹⁴⁾

Good oral health depends on the establishment of the key behaviors of tooth brushing with fluoride toothpaste and controlling sugar snacking. Schools are ideal settings in which to reach children, parents and community members. School oral health programs can offer health education, dental screenings and dental preventive services. Schools may be the only place for children at high risk of dental disease to have access to oral health services.⁽¹⁵⁾

Early identification of dental caries in children is important and essential component of an oral health program. The emphasis on earlier identification creates the opportunity to provide the benefits of early

intervention. Screening using FDI caries matrix combined with adequate follow-up can achieve major reduction in severity, especially in high risk groups or individual children. It is critical to support oral health promotion in school to focus on early signs of dental caries. It is also necessary to concentrate efforts on assessing the severity of tooth decay and untreated caries in children in order to optimize the quality of their life and health in the future.

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บทคัดย่อ: การประเมินโรคฟันผุด้วย FDI Caries Matrix ในเด็กก่อนวัยเรียน ในอำเภอเมือง นครสวรรค์

กนกพร โพธิ์หอม ท.บ. M.P.H.M.

กลุ่มงานทันตกรรม โรงพยาบาลสวรรค์ประชารักษ์

วารสารวิชาการสาธารณสุข 2558;24:554-62.

การประเมินโรคฟันผุโดยใช้เกณฑ์ขององค์การอนามัยโลกจะประเมินได้เฉพาะฟันผุที่การลุกลามอย่างชัดเจน FDI caries matrix เป็นดัชนีที่พัฒนาเพื่อประเมินโรคฟันผุที่ครอบคลุมมากขึ้น วัตถุประสงค์ของการศึกษาครั้งนี้มีขึ้นเพื่อประเมินโรคฟันผุในเด็กอนุบาลอายุ 4-6 ปีจำนวน 563 คนจากโรงเรียนที่ได้รับการเลือกแบบเจาะจงจำนวน 3 แห่งในเขตเทศบาลอำเภอเมือง นครสวรรค์ ทำการตรวจฟันที่แห้งจากการเช็ดด้วยก๊อชโดยใช้กระจกส่องปากแบบผิวเรียบภายใต้แสงธรรมชาติ วิเคราะห์ข้อมูลด้วยสถิติพรรณนา ไคสแควร์ และการวิเคราะห์ความแปรปรวนที่ระดับความเชื่อมั่น 0.05 ความชุกของโรคฟันผุในเด็กอายุ 4, 5 และ 6 ปี มีค่าร้อยละ 78.2, 89.8 และ 94.1 ตามลำดับ อัตราฟันผุที่ไม่ได้รับการรักษา ($pu_{fa} > 0$) มีค่าร้อยละ 44.9, 59.6 และ 74.1 ตามลำดับ ฟันผุที่ไม่ได้รับการรักษามีค่าเฉลี่ยเป็น 1.78 ± 2.70 , 3.03 ± 3.72 และ 4.18 ± 3.89 ซึ่งต่อคน ความชุกของโรคฟันผุ/ฟันผุที่ไม่ได้รับการรักษา และค่าเฉลี่ยของฟันผุที่ไม่ได้รับการรักษามีค่าเพิ่มขึ้นตามอายุและมีความสัมพันธ์อย่างมีนัยสำคัญทางสถิติ ข้อมูลที่ได้จากการประเมินฟันผุโดยใช้ FDI caries matrix มีความชัดเจนในด้านการลุกลามของฟันผุ ทำให้สามารถหาวิธีการที่เหมาะสมเพื่อป้องกันฟันผุในระยะต่างๆ ได้มากกว่า

คำสำคัญ: การประเมินฟันผุ, ดัชนี FDI caries matrix, เด็กก่อนวัยเรียน