Relationship Between Dental Caries Status, Nutritional Status, Snack Foods, and Sugar-Sweetened Beverages Consumption Among Primary Schoolchildren Grade 4-6 in Nongbua Khamsaen School, Na Klang District, Nongbua Lampoo Province, Thailand

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Objective: To evaluate relationship between dental caries status, nutritional status, snack foods, and sugar-sweetened beverages consumption among primary schoolchildren grade 4-6 in Na Klang district, Nongbua Lampoo province, Thailand in 2011.

Material and Method: The subjects included 111 children (57 boys and 54 girls), aged 11 and 12 years, who were studying in grades 4 to 6 in the year 2011. The data were collected through questionnaires, interview, and oral examination. Results were obtained by means of descriptive, bivariate, and multiple logistic regression analyses.

Results: Prevalence of dental caries in the children was 82.9% with the mean DMFT of 2.28. The dental caries prevalence in permanent and primary dentitions was 69.4% and 34.2%, respectively. About 10.2% of the children were underweight, 13.0% were obese, and 7.5% were stunting. Findings from the final multiple logistic regression models showed that weight-for-age malnutrition as well as eating sweets before bedtime were significantly related to dental caries in primary dentition, with the adjusted odds ratio (95% CI) being 6.68 (1.57, 28.41) and 5.34 (1.60, 17.77), respectively. Family income was significantly related to permanent dental caries with the odds ratio (95% CI) being 9.60 (1.89, 48.59).

Conclusion: Nutritional status is associated with dental caries among these elementary schoolchildren. Larger studies extending to cover other elementary schools in Na Klang district should be conducted so that the results will be representative of all elementary schools in Na Klang district, Nongbua Lampoo province.

Keywords: Dental caries, Nutritional status, Schoolchildren, Thailand

High prevalence of primary and permanent dental caries in children is major public health problems in Thailand. Dental caries is a multi-factorial disease whereby the amounts and frequencies of consumption of free sugars are the most important etiological factors in its development[1-6]. Having good oral health enables individuals to communicate effectively to enjoy food, to speak well, to enjoy a higher quality of life, and to have both a higher self-esteem and social confidence[7]. On the other hand, oral diseases can cause serious long-term problems regarding both social (*e.g.* social confidence), and physical (*e.g.* heart disease) aspects[8]. Tooth infection causes pain and restlessness to children, resulting in decreased growth hormone and increased metabolic rate, thus malnutrition in children can occur[9].

Nowadays dietary habits in children have changed. Amount and frequency of sugar consumption has increased, causing dental problems and malnutrition[2]. The impact of this relatively sudden transition from the traditional way of feeding and preparing children's meals, to a new lifestyle of living and eating, might be another reason for dental caries

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development in young children[10], in particular in developing countries[11]. Snacks, often high in refined carbohydrate, have been eaten as a treat between meals and all types of sticky and sweet foods are sold in school canteens at affordable cost[5]. What people eat is affected by socioeconomic status, the cost of food, the industrialization of agriculture, the location of food outlets, and the effects of advertising and marketing[12]. People of low income ate healthier choices but those of high income added less healthy choices[13]. Television advertisements play an important role in the marketing strategies for sugary drinks and foods[5]. In-school product marketing and sales promotion of high-fat snacks and carbonated, sweetened beverages have been a growing concern[14]. Based on previous research evidence, diet is still a key factor associated with dental caries[4,15].

The oral health survey in 2008 of Na Klang district[16] found that caries prevalence among 12-year-old students was higher than that of Nongbua Lampoo province[17] and the national oral health survey in 2007[18] (78.49%, 70.8%, and 56.87%, respectively). Prior research has evaluated the relationship between dental caries and nutritional status among preschool children[3,19], but the elementary school children are different as they have more freedom to buy foods as well as their oral environments are changing from deciduous to permanent teeth, which can increase caries susceptibility. Thus, the purpose of the present study was set to evaluate the relationship between dental caries, nutritional status, sugar sweetened snacks and beverages consumption among grade 4 to 6 schoolchildren, in Na Klang district, Nongbua Lampoo province, Thailand.

Material and Method
Subjects

The samples consisted of students aged 11 and 12 years, who were studying in grades 4 to 6, Nongbua Khamsaen school, Na Klang district, Nongbua Lampoo province in 2011. Altogether, 111 children (57 boys and 54 girls) participated in the present study. The students and parents received information about the study and signed a consent form to take part in the present study. The present study protocol was approved by the Human Research Ethics Committee of Khon Kaen University.

Data collection

The data were collected through questionnaires, interview, and oral examination, which was modified from World Health Organization[20-22] and the national oral health survey of Thailand[18,23]. After signing the present study consent form, the children were given a dental examination of oral health status by a dentist who had previously been trained for assessment oral health indices correctly and had kappa values for repeatability of at least 80%. Pre-packed sterilized oral examination kits, which contained a plain mouth mirror and a blunt probe, were used. After the examination, the students were interviewed by a well-trained interviewer and their parents were given the questionnaires about family-related factors. The children's weight and height were measured annually, and the nutritional status was calculated.

Dental examination was conducted mainly to assess dental caries and periodontal conditions of the children, based on WHO criteria (WHO, 1977). The dental caries status was assessed using decayed, missing, and filled permanent teeth (DMFT) and periodontal status was measured using the Community Periodontal Index (CPI).

The questionnaires comprised questions including age, gender, father and mother's level of education, family income, dental visits, type of dental visit, self-assessment of oral health, oral hygiene practices, frequency and timing of consumption of dietary items, consumption of drinks, bedtime snacks, and other potential risk indicators for dental caries. Intake of snacks and drinks was categorized into every day, always, sometimes, and never.

Data management and data analysis

Data were collected on papers forms, and entered using data entry software. Data management and analysis was done using SPSS for Windows version 16.0. Descriptive and analytical statistics were obtained. Descriptive statistics including mean, standard deviation, and proportion were used in describing the basic information such as sex, oral health status, oral hygiene care behaviors, nutritional status, family-related factors, and snacks and beverages consumption. Bivariate relationships between dental caries, of both primary and permanent dentitions, with potential predictors, were assessed using either parametric or non-parametric statistics depending on the assumptions of the statistics being used. The final models related dental caries, in primary dentition or permanent dentition, to its predictors were achieved using multiple logistic regression analyses. The outcomes in the final multiple logistic regression models were defined as primary dentition caries and

permanent dentition caries (having one or more carious teeth compared to no carious teeth). A p-value of less them 0.05 was considered statistical significant.

Data quality control

Before collecting the dental data, the examiner was trained to measure every index until she was capable of measuring correctly according to the principles and standards of the experts on the use of the indices. The repeatability of the measurements was evaluated by gaining a kappa value of more than 80%. To ensure consistency of the whole examination, repeated measurements were done in about 10% of the samples and the kappa value for the duplications was higher than 80%. It was assumed that sample responses were accurate and honest, but this might be questioned since their validity and reliability were not examined. However, every effort was made to gain truthful answers. The students and parents were asked to respond to the best of their knowledge, and were told beforehand that there was no right or wrong answers; they only had to give honest responses.

Results

One hundred eleven students participated in the present study, consisting of 57 boys (51.4%) and 54 girls (48.6%). Concerning oral health status, prevalence of dental caries among these schoolchildren was 82.9% with the mean DMFT of 2.28. The dental caries prevalence in permanent and primary dentitions was 69.4% and 32.2%, respectively. About 10.2% of the students were underweight, 13% were obese, and 7.5% were stunting. About 60.2% of parents had average monthly income less than 5,000 baht.

In the past year, 59.5% of the students had dental pain and 48.6% had eating problems resulting from pain. Most students had visited dentists (78.2%) for annual dental examination (45.3%), or toothache (41.9%) (Table 1). In addition, findings from the consumption behaviors survey showed that children preferred plain milk (22.5%), ice cream (18%), and sweet milk (17.1%). Dried squid/fish and tea, coffee, malt beverages were chosen by only 7.3% and 3.6%, respectively (Table 2). Most students ate snacks before going home (64.9%) and 13.5% of students tended to eat snacks before bedtime. However, 82% of the children forgot to re-brushing teeth when eating snacks before bedtime (Table 3).

The bivariate analyses showed that oral examination visit, fish snack consumption, tea,

coffee, chocolate, malt drinking, family income and weight-for-age malnutrition were significantly related to permanent dental caries (Table 4). The height-for-age malnutrition, weight-for-age malnutrition, and eating sweets before bedtime were significantly related to primary dental caries (Table 5). Findings from the final multiple logistic regression models showed that weight-for-age malnutrition as well as eating sweets before bedtime were significantly related to dental caries in primary dentition, with the adjusted odds ratio (95% CI) being 6.682 (1.572, 28.409) and 5.335 (1.602, 17.769), respectively (Table 6), while family income was significantly related to permanent dental caries with the odds ratio (95% CI) being 9.6 (1.896, 48.599) (Table 7).

Table 1. Basic characteristics, oral health status and nutritional status (n = 111)

Status	n (%)
Sex	
Male	57 (51.40)
Female	54 (48.60)
Average monthly income of parents	
Less than 2,000 baht	31 (30.10)
2,001-5,000 baht	31 (30.10)
5,000-10,000 baht	20 (19.40)
10,001-20,000 baht	21 (20.40)
Having decayed, missing, and filled teeth (DMFT)	92 (82.90)
Having permanent dental caries	77 (69.40)
Having primary dental caries	38 (34.20)
Weight-for-age nutrition	
Obesity	14 (13.00)
Normal	83 (76.90)
Underweight	11 (10.20)
Height-for-age	
Tall	14 (13.00)
Normal	86 (79.60)
Short	8 (7.50)
Having toothache in 1 year ago	66 (59.50)
Having eating problem because of pain in 1 year ago	54 (48.60)
History of oral examination from dentist	105 (95.50)
Ever been to the hospital	86 (78.20)
For annual dental examination	39 (45.30)
Due to toothache	36 (41.90)

Table 2. Frequency of snacks and sweetened-drinks consumption (n = 111)

Items of snack and sweetened-drink	Number of students (%)			
	Everyday	Always	Sometimes	Never
Plain milk	25 (22.5)	32 (28.8)	53 (47.7)	1 (0.9)
Sweet milk, soy milk, fermented milk	19 (17.1)	29 (26.1)	63 (56.8)	0 (0.0)
Dried squid/fish, cereal	8 (7.3)	22 (20.0)	80 (72.7)	0 (0.0)
Ice cream	20 (18.0)	31 (27.9)	60 (54.1)	0 (0.0)
Soft drinks	2 (1.80)	9 (8.1)	98 (88.3)	2 (1.8)
Tea, coffee, chocolate malt drinks	4 (3.60)	32 (28.8)	74 (64.0)	4 (3.6)

Table 3. Snacks consumption and oral hygiene care behavior (n = 111)

Status	Number of students (%)
Snacks and drinks consumption periods	
During meal	54 (48.60)
After lunch brushing	28 (25.20)
Between class period	20 (18.00)
Before going home	72 (64.90)
Before bedtime	15 (13.50)
Uncertain	48 (43.20)
Re-brushing before bedtime	91 (82.00)

Table 4. Factors associated with permanent dentition caries in the bivariate analysis (n = 111)

Variable	p-value
Gender	0.681[b]
Family income	0.020[a]
Parent's education	0.191[a]
Weight-for-age nutrition	0.015[a]
Height-for-age nutrition	0.603[a]
Community periodontal index (CPI)	0.521[b]
Simplified debris index (DI-S)	0.656[b]
History of oral examination from dentist in 1 year ago	0.042[b]
Re-brushing before bedtime	0.410[b]
Eating sweets before bedtime	0.772[b]
Dried squid/fish, cereal consumption	0.017[a]
Soft drink drinking	0.521[a]
Tea, coffee, chocolate, malt drink drinking	0.008[b]

[a] Test of difference between proportions (Chi-square test)
[b] Test of difference between proportions (Fisher's exact test)

Table 5. Factors associated with primary dentition caries in the bivariate analysis (n = 111)

Variable	p-value
Gender	0.556[b]
Family income	0.859[a]
Parent's education	0.319[a]
Weight-for-age nutrition	0.011[a]
Height-for-age nutrition	0.002[a]
Community periodontal index (CPI)	0.546[b]
Simplified debris index (DI-S)	1.000[b]
History of oral examination from dentist in 1 year ago	0.512[b]
Re-brushing before bedtime	0.169[b]
Eating sweets before bedtime	0.007[b]
Dried squid/fish, cereal consumption	0.156[a]
Soft drink drinking	0.809[a]
Tea, coffee, chocolate, malt drink drinking	0.832[b]

[a] Test of difference between proportions (Chi-square test)
[b] Test of difference between proportions (Fisher's exact test)

Discussion

The results of the present study showed that caries free in grade 4 to 6 students in Nongbua Khamsaen school was much lower than the national oral health target in 2011[24] (17.1% and 45% respectively). The present study found no association between gender and dental caries, which was different from prior studies[17,25,26]. Previous studies found that a significant higher proportion of the children with visible plaque had caries[3], and low frequency of tooth brushing (< two times/day) was significantly associated with dental caries[4]. However, the present study did not find an association between dental caries and oral hygiene status.

Table 6. Factors associated with primary dentition caries in the final multiple logistic regression model*

Variable	Adjusted odds ratio (95% CI)	p-value
Nutritional status by weight-for-age		
Underweight	6.682 (1.572, 28.409)	0.010
Normal	1	
Eating sweets before bedtime		
Yes	5.335 (1.602, 17.769)	0.006
No	1	

* Nagelkerke R Square = 19.5%, model significant at p = 0.001

Table 7. Factors associated with permanent dentition caries in the final multiple logistic regression model*

Variable	Odds ratio (95% CI)	p-value
Family income		
5,001-10,000 baht	9.6 (1.896,48.599)	0.006
5,000 baht and lower	1	

* Nagelkerke R Squarea = 13.6%, model significant at p = 0.014

Findings that history of dental visit in the past year was associated with permanent dentition caries, agree well with the results of prior studies[27-29]. The reason might be that in many developing countries, access to oral health services was limited, and teeth were often left untreated or are extracted because of pain or discomfort[30]. Parents might have been unaware of the need of treatment, or perhaps, felt that their children were too young to attend a dental clinic, and therefore, they did not take their children to the clinic until pain was experienced[29].

That average household income of parents was associated with permanent teeth decayed confirmed a study by Jurgensen and Petersen in 2009[27]. A previous study also reported that children whose parents had good social status, or high income consumed a lot more juice and sweets[31], or were able to buy more sweets and snacks[25,32]. However, several recent studies reported that children in high-income families had the lowest dental caries[29], while children from the poorest households had higher mean DMFT/DMFS scores[12,33]. One likely reason was that dental caries, along with numerous other diseases, was often concentrated in low socio-economic status families, where prevention and treatment services are often lacking[34]. However, no association was detected between parent's education and dental caries in the present study, which differed from past studies[4,10,25,29,35].

The finding that permanent dentition caries did demonstrate some connection with dried squid/fish consumption and tea, coffee, chocolate, malt drinking, supports a previous study by the foundation of oral health[36]. Dried squid/fish was considered low-risk of caries because of its less-sugar and saliva-stimulation properties[37,38]. Quite clear correlations between dental caries and sweetened-drinking and snack consumption have been previously reported[10,15,39,40]. Frequent consumption of simple carbohydrates, primarily in the form of dietary sugars was significantly associated with increased dental caries risk[12,26]. Increased consumption of sugar sweetened beverages, candy, chips, and cookies provides excessive calories to the child, increases the risk of caries, and when combined with inadequate intake of fruits and vegetables, deprived the child of nutrients essential to growth and development[12].

The findings have shown a quite clear association between underweight malnutrition and primary dental caries. Several recent studies have reported the association between dental caries and obesity[15,26,32,41]. While some research found that, the overweight children had a lower DMFT because these children came from families that provided fluoridated dentifrices more often, and probably came from families with better access to dental services compared to thin children[33].

Conclusion

Nutritional status did demonstrate a direct connection with primary dental caries. Thus, weight-for-age nutrition might be a suitable indicator to reflect caries status, especially in the underweight group. In contrast, children who have tooth decay tend to be underweight in the future. The authors should reduce the malnutrition risk in children by caring for their teeth so that they can chew food better. Moreover, the present study found connections between snacks-food consumption and dental caries. Dried squid/fish group is a low risk of tooth decay. While tea, coffee, chocolate, and malt drinking is a high-risk group. This information might be useful to drive the environmental policy of the primary schools to select only tooth friendly snacks. It is also clear in the literature that sugar consumption is associated with dental caries and

obesity. Hence, the adoption of healthy dietary habits, with a controlled sugar intake, could improve both oral and general health of the children. The present study also confirms that children who eat sweets before bedtime are likely to get dental caries. Therefore, more effort should be put on educating about oral hygiene care and snacks selection for the schoolchildren.

This is the first study in Na Klang district where the relationship between dental caries, nutritional status, sugar-sweetened snacks, and beverages consumption among primary schoolchildren has been evaluated. Furthermore, the importance of nutritional status and snacks-food consumption relating to dental caries has been confirmed. In addition, some limitations of the study should be mentioned. Based on the type of a cross-sectional study, it is not possible to infer a causal relationship between dental caries and nutrition status. Conducting a longitudinal study would have provided stronger evidence on the temporal relationship between dietary factors and dental caries. Also, due to a small sample size, larger studies extending to cover other elementary schools in Na Klang district should be conducted so that the study will be large enough to achieve adequate statistical power as well as the results will be representative of all elementary schools in Na Klang district. Thus, the findings may benefit preventive planning to reduce dental caries among students in the future.

Acknowledgement

Potential conflict of interest

None.

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ความสัมพันธ์ระหว่างสภาวะฟันผุ ภาวะโภชนาการ การบริโภคขนมและเครื่องดื่มที่มีรสหวานในเด็กนักเรียนชั้นประถมศึกษาปีที่ 4-6 ในตำบลนากลาง อำเภอหนองบัวลำภู ประเทศไทย

จุฑามาศ เหลืองเพียรสมุท, สุภาภรณ์ ฉัตรชัยวิวัฒนา, เบญจา มุกตพันธุ์, วรางคณา อินทโลหิต

วัตถุประสงค์: เพื่อประเมินสภาวะฟันผุกับภาวะโภชนาการ การบริโภคขนมและเครื่องดื่มที่มีรสหวานในเด็กนักเรียนชั้นประถมศึกษาปีที่ 4-6 ใน อำเภอนากลาง จังหวัดหนองบัวลำภู ประเทศไทย ในปี พ.ศ. 2554

วัสดุและวิธีการ: กลุ่มตัวอย่างประกอบด้วยนักเรียนจำนวน 111 คน เป็นเด็กชาย 57 คน และเด็กหญิง 54 คน มีอายุ 11-12 ปี และศึกษาชั้นประถมศึกษาปีที่ 4-6 ในปี พ.ศ. 2554 เก็บข้อมูลโดยแบบสอบถาม การสัมภาษณ์ และการตรวจช่องปาก การวิเคราะห์ข้อมูลประกอบด้วยการวิเคราะห์ข้อมูลเชิงพรรณนา การวิเคราะห์ความสัมพันธ์ของตัวแปรทีละหนึ่งคู่ความสัมพันธ์ และการวิเคราะห์ความสัมพันธ์ระหว่างตัวแปรตามกับตัวแปรอิสระมากกว่าหนึ่งตัวพร้อมกันโดยใช้สมการถดถอยพหุคูณลอจิสติก

ผลการศึกษา: นักเรียนมีฟันผุร้อยละ 82.9 ค่าเฉลี่ยฟันผุถอนอุด 2.28 โดยนักเรียนที่ฟันแท้ผุยังไม่ได้รับการรักษามีจำนวนร้อยละ 69.4 และเด็กนักเรียนส่วนใหญ่มีฟันน้ำนมผุร้อยละ 34.2 ร้อยละ 10.2 ของกลุ่มตัวอย่างมีน้ำหนักต่ำกว่าเกณฑ์ ร้อยละ 13 มีน้ำหนักสูงกว่าเกณฑ์ และร้อยละ 7.5 มีภาวะขาดสารอาหารเรื้อรัง ในการวิเคราะห์ความสัมพันธ์โดยใช้สมการถดถอยพหุคูณลอจิสติก พบว่าภาวะทุพโภชนาการน้ำหนักตามเกณฑ์อายุ และการรับประทานขนมก่อนนอนมีความสัมพันธ์กับสภาวะฟันน้ำนมผุอย่างมีนัยสำคัญทางสถิติ โดยมีค่าอัตราส่วนความเสี่ยงที่ปรับแล้ว (ช่วงเชื่อมั่นร้อยละ 95) เท่ากับ 6.68 (1.57, 28.41) และ 5.33 (1.60, 17.77) ตามลำดับ ส่วนรายได้ครอบครัวมีความสัมพันธ์กับสภาวะฟันแท้ผุอย่างมีนัยสำคัญทางสถิติ โดยมีค่าอัตราส่วนความเสี่ยง (ช่วงเชื่อมั่นร้อยละ 95) เท่ากับ 9.60 (1.89, 48.59)

สรุป: ผลการศึกษายืนยันความสัมพันธ์ระหว่างภาวะโภชนาการ การรับประทานอาหารหวานก่อนเข้านอน และรายได้ครอบครัวกับสภาวะฟันผุ และควรทำการศึกษาเพิ่มเติมโดยขยายการศึกษาไปในโรงเรียนประถมศึกษาอื่นๆ ของอำเภอนากลาง เพื่อให้ข้อมูลที่ได้เป็นตัวแทนของโรงเรียนประถมศึกษาทั้งหมดในอำเภอนากลาง จังหวัดหนองบัวลำภูต่อไป