

ASSOCIATION BETWEEN NUTRITIONAL STATUS AND DENTAL CARIES IN PERMANENT DENTITION AMONG PRIMARY SCHOOLCHILDREN AGED 12-14 YEARS, THAILAND

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Abstract. This cross-sectional study assessed associations between nutrition and dental caries in permanent dentition and identified oral hygiene indicators among older children aged 12-14 years in primary schools in Thailand. The study was comprised of 862 schoolchildren from five provinces representing five regions of Thailand, from both rural and urban areas, including Bangkok. The dental hygiene status was assessed by evaluating for decayed teeth, missing teeth due to decay, and filled teeth index (DMFT index). Weight and height were measured to evaluate the nutritional status; hygiene practices assessed by interview. The results show a negative relationship between nutritional status and the DMFT index, which increased when the nutritional status decreased (Spearman's rho correlation = -0.140, $p < 0.001$). The results from multiple logistic regression analysis showed normal weight and thin schoolchildren were more likely to have a DMFT of at least 1 by 1.94 times (OR = 1.94; 95%CI = 1.25-3.00, $p = 0.004$) and 2.22 times (OR = 2.22; 95%CI = 1.20-4.09, $p = 0.001$), respectively, compared to overweight and obese children. Normal and thin schoolchildren had a higher risk for dental caries than overweight and obese children aged 12-14 years in Thailand. School health promotion activities should emphasize eating habit improvement in order to reduce the incidence of caries.

INTRODUCTION

In Thailand, primary schoolchildren, age 12-14 years, face various public health problems. The prevalence of obesity has increased dramatically in primary schoolchildren (Jirapinyo, 2005). Overnutrition and dental caries in permanent dentition are also prevalent. The National Oral Health Survey in Thailand in 2000 reported that the pro-

portion of schoolchildren age 12 years old free from dental caries was 42.7%, with an index of 1.64 for decayed, missing and filled permanent teeth (DMFT) (Department of Dental Health, 2002). The Thai Ministry of Public Health declared that obesity and dental caries are public health problems for schoolchildren, but few studies exist evaluating the relationship between nutritional status and dental caries.

Earlier studies have shown different associations between caries status and overweight children by different age groups. One study found overweight children are at greater risk for caries in primary dentition

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than normal weight children (Marshall *et al*, 2007). In contrast, a study by NHANES III in young children showed overweight status may be associated with decreased rates of caries in children aged 12-18 years old (Kopyka-Kedzierawski *et al*, 2007).

In the present study, we assessed the possible associations between dental caries in permanent dentition and nutritional status, and identified oral hygiene practice indicators among older primary schoolchildren aged 12-14 years in Thailand.

MATERIALS AND METHODS

Studied subjects

Thailand is divided into 77 provinces in five regions: *ie*, central, north, east, south, and northeast. One to two provinces from each region were selected based on availability and accessibility to local dentists from provincial health offices who had experience conducting the National Oral Health Survey. Local dentists in each province selected one school in an urban area and one school in a rural area from his or her province, as well as one school in the greater Bangkok Metropolitan Area. In each school, 30-40 children aged 12-14 years from one to two classrooms were included in the study. Of a total of 900 schoolchildren, 38 were excluded due to incomplete data. Therefore, 862 schoolchildren (411 boys, 451 girls) were included in the analysis. Research protocols were approved by the ethics committee of Mahidol University, Bangkok Thailand. Informed consent was obtained from the parents of the schoolchildren before oral examination and interview.

Questionnaires

From reviewing relevant literature, important oral hygiene practice indicators for schoolchildren were identified: 1) brushing teeth at least twice a day, 2) using fluoride toothpaste, 3) consuming snacks less than

twice a day, 4) having regular checkups every six months, 5) receiving oral health education every three months, 6) brushing teeth after lunch at school, and 7) having a chance to buy snacks during school breaks. (Burt *et al*, 1999; Lingstrom *et al*, 2000; Moynihan, 2002; Moynihan and Petersen, 2004; David *et al*, 2005). A self-administered questionnaire was constructed regarding residential area (urban/rural), age, gender of schoolchildren and seven indicators. The questionnaire was pilot tested among schoolchildren in Bangkok to improve validity before use. The questionnaires were distributed to school children in the classroom and collected before participating in oral health examinations.

Oral health examination

Dental caries examinations were performed in the classroom under natural light. The technique used in this study was based on the publication recommended by the World Health Organization concerning the DMFT index (World Health Organization, 1997). Examiners were local dentists from provincial health offices who had experience conducting the National Oral Health Survey. Calibration of examiners was conducted prior to data collection at provincial health offices.

Anthropometric measures

The weight in kilograms and height in centimeters of the schoolchildren were measured on the same day as the oral health examination. Nutritional status was calculated according to the Division of Nutrition, Thai Ministry of Public Health standard manual using weight for height in Thai children. Median with standard deviation (SD) was used as the cutoff point for nutritional status. Nutritional status was categorized into five groups: very thin, less than median minus 2 SD; thin, median minus 2 SD to median minus 1.5 SD; normal, median minus 1.5 SD to median plus 1.5 SD; overweight,

median plus 1.5 SD to plus 2 SD; and obese, more than median plus 2 SD (Department of Nutrition, 2000).

Statistical analysis

Since DMFT, which is a continuous variable, did not have normal distribution ($p < 0.001$ from a one-sample Kolmogorov-Smirnov test), nonparametric statistics were used to compare the median DMFT among nutritional status groups. Unconditional logistic regression analysis, enter method, was used to assess the association by odds ratio with 95% confidence interval (95% CI) between nutritional status and DMFT per person. Nutritional status, an independent variable, was regrouped by combining the overweight obese groups to increase sample size, and resulting in 3 categories of nutritional status: thin, normal, and overweight plus obese. The dental caries status, a dependent variable, was categorized into dichotomous variables: DMFT ≥ 1 and DMFT = 0 (caries free). Other confounding variables included in the final model were seven oral health practice indicators, namely: brushing teeth more than once per day (yes/no), using fluoride tooth paste (yes/no), having snacks more than three times per day (yes/no), having dental visit more than twice a year (yes/no), receiving oral health education every 3

months (yes/no), residential area (rural/urban), age (years) and gender (male/female).

RESULTS

The urban to rural ratio in the study population was almost equal (48.5%: 51.5%) respectively, similar to the gender proportion of gender, 47.7% male and 52.3% female. The ages ranged from 12 to 14 years old with a mean of 12.75 ± 0.76 years.

A large proportion of study population had normal nutritional status, accounting for 78.3% of total subjects; 5.3% were overweight, 6.3%, obese and 10.1%, thin. Of the total subjects 37.9% were free from caries, while 56.0% of overweight and obese group were free from caries.

There was a significant negative correlation between nutritional status and DMFT (Spearman's rho correlation = -0.140 , $p < 0.001$). The means DMFT in the total study population was 1.93 ± 2.16 per person. The means of DMFT values among the normal, thin, overweight and obese schoolchildren were 2.03 ± 2.20 , 2.19 ± 2.19 , 1.23 ± 1.86 and 0.89 ± 1.36 per person, respectively. The differences between the mean DMFT values among the 4 groups were significant ($p < 0.001$) (Table 1).

Table 1
DMFT and nutritional status among Thai schoolchildren aged 12-14 years.

DMFT ^a	Nutritional status				
	Number	Means (SD) ^b	Median	Minimum	Maximum
Normal	675	2.03 (2.20)	2.00	0.00	10.00
Thin	87	2.19 (2.19)	2.00	0.00	12.00
Overweight	46	1.23 (1.86)	0.00	0.00	6.00
Obese	54	0.89 (1.36)	0.00	0.00	6.00
Total	862	1.93 (2.16)	1.00	0.00	12.00

*Kruskal Wallis test, chi-square = 22.79, df = 3, $p < 0.001$ for differences of medians

^aDMFT, Decayed, missing, filled teeth; ^bSD, standard deviation

Table 2
Comparison of median DMFT value among nutritional status groups in Thai school children.

Nutritional status	<i>p</i> -value ^a
Thin to normal	0.41
Thin to overweight	0.01 ^b
Thin to obese	<0.001 ^b
Normal to overweight	0.01 ^b
Normal to obese	<0.001 ^b
Overweight to obese	0.69

^aMann-Whitney test; ^bSignificant comparison of two groups; DMFT, decayed, missing, filled teeth

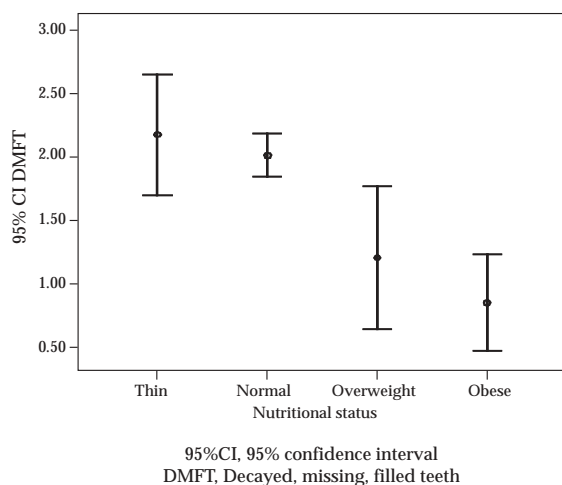


Fig 1—Comparison of DMFT nutritional status in Thai schoolchildren.

No significant differences were found when comparing the median of DMFT between the thin and normal children ($p = 0.41$), and between the overweight and obese children ($p=0.69$). There were significant differences between thin and overweight children ($p = 0.01$), thin and obese children ($p < 0.001$), normal and overweight children ($p=0.01$) and normal and obese children

($p < 0.001$) (Table 2).

Results from multiple logistic regression analysis demonstrated thin children were 2.22 times more likely to have a DMFT of at least 1 (OR= 2.22; 95%CI=1.20-4.09, $p = 0.010$) than overweight and obese children. Children with a normal nutritional status were 1.94 times (OR=1.915; 95%CI=1.20-3.00, $p = 0.003$) more likely to have a DMFT at least 1 than overweight and obese children (Table 3).

No association was found between the seven oral hygiene practice indicators and dental caries status in the studied population. The results reveal a low number of individuals with proper oral hygiene; 13.0% had regular dental checkups every six months, 23.3% brushed their teeth after lunch at school and 28.4% received oral health education every 3 months (Table 4).

DISCUSSION

This cross-sectional study demonstrated a negative relationships between nutritional status and dental caries among the study subjects. Thin and normal weight schoolchildren had a higher risk (2.22 and 1.94 times, respectively) of having a DMFT of at least 1 compared to overweight and obese children. The findings of this study confirm the data from the National Health and Nutrition Examination Survey (NHANSE III, 1999-2000) conducted by Kopycha-Kedzierawski (2007) which showed overweight status may be associated with decreased rates of caries in older children. However, the relationship was inconclusive.

Overweight and obesity are usually caused by a total daily energy intake higher than total daily energy expenditure (Kopycha-Kedzierawski, 2007). Increasing the intake of snacks can promote dental decay (Burt and Eklund, 1999). In an attempt to explain the negative relationship between nutritional status and dental caries, some studies include

Table 3
Adjusted odds ratios (OR) with 95% confidence intervals (95%CI) of having a DMFT of at least 1 by nutritional status.

Nutritional status	OR ^a	95%CI	p-value
Normal	1.94	1.25-3.00	0.003
Thin	2.22	1.27-4.09	0.010
Overweight and obese	1 ^b		

^aAdjusted for frequency of brushing, using fluoride tooth paste, snacking, dental visits, receiving oral health education, residential area, gender and age

^breference group; DMFT, decayed, missing, filled teeth

Table 4
Number and percentage of school children with various oral health practice indicators.

Oral health indicators	Urban area		Rural area		Total	
	Number	%	Number	%	Number	%
Brushing teeth at least twice a day	285	68.2	228	51.5	513	59.6
Using fluoride toothpaste	402	96.2	416	93.9	818	95.0
Consuming snacks less than twice a day	254	60.8	296	66.8	550	63.9
Having regular checkups every six months	53	12.7	59	13.4	112	13.0
Receiving oral health education every three months	108	25.8	131	30.0	239	28.4
Brushing teeth after lunch at school	95	22.7	103	23.3	198	23.3
Having a chance to buy snacks during school breaks	383	91.6	392	88.5	775	90.0

an association between the main meal and snacks. Studies have shown main meals are usually higher in protein and fat, and lower in sugar than snacks. Snacks have a relatively high total sugar content. Snack food has been associated with dental caries (Summerbell *et al*, 1995). In relatively small eaters, increased kilocalories and total sugar content of snacks are associated with decreased kilocalorie and total sugar content at main meals (Morgan *et al*, 1988). A longitudinal investigation of primary dentition showed higher exposure to food sugar and starch at mealtime decreased caries risk, while higher exposure to sugar from snacks

increased caries risk (Marshall *et al*, 2005).

In this study, 36.1% of school children had snacks more than three times per day. Of these, 9.0% and 80.7% were thin and normal weight, respectively, and 10.3% were overweight and obese. This evidence shows a higher frequency of snacking among thin and normal children than overweight and obese children in the studied population. Popular snacks among Thai schoolchildren include carbonated soft drinks and packaged snacks, all of these were available at school. These types of snacks are not usually nutritious food and can lead to decreased intake at the main meal. A sedentary lifestyle that

includes playing computer games, watching television and reduced exercise may increase overweight and obesity, leading to complications in Thai primary schoolchildren. Studies in Thailand have demonstrated that obese children eat fried chicken significantly more often than children of normal nutritional status (Sirikulchanonta *et al*, 2006).

As a result, health promotion activities in school should emphasize healthful eating practices; especially limiting beverages containing sugar, to only occasionally between meals, and providing an appropriate amount of food containing sugar and starch at the main meal. Cooperation with the Ministry of Education in controlling the quality, quantity and frequency of food in the school environment is recommended for better nutritional status and reduced caries among this group of children.

The main limitation of this study was its cross-sectional study design, but the time to develop overweight or obesity and dental caries may be nearly the same. This study suggests a possible causal relationship between nutritional status and caries. Further study is needed to explain the negative relationship between nutritional status and caries and to gain insight into the association between overweight status and decreased risk of dental caries.

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