# Relationship between Nutritional Status and Dental Caries in Elementary Students, Samliam Municipal School, Khon Kaen Province, Thailand

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***Background and Objective:*** *Malnutrition and dental caries are important problems in elementary students, Thailand. The objective of this study was to explore the relationship between nutritional status and dental caries in Samliam municipal elementary students, Khon Kaen Province.*
***Material and Method:*** *This cross-sectional study was conducted during March to August, 2015. A total of 210 Samliam municipal elementary students volunteered to participate in this study. Data were collected from questionnaires, weight and height measurements, and oral examination records. The oral health status was recorded using the decayed, missing, and filled teeth (DMFT) index and Plaque index. The nutritional status was measured using body mass index for age from WHO criteria (2007), weight for age and height for age.*
***Results:*** *The average age of the participants was 9.3±1.7 years (6 to 12 years). The prevalence rate of dental caries was 73.4%. Decay, missing and filling of deciduous teeth (dmft) were of 3.1±3.6 teeth/person. Decay, missing and filling of permanent teeth (DMFT) were of 0.4±2.9 teeth/person. The participant's nutritional status included normal (65.2%), thinness (5.7%), overweight (10.2%) and obesity (18.6%). The present study found that there was a significant relationship between high height for age and dental caries.*
***Conclusion:*** *There were a high prevalence of deciduous dental caries and malnutrition (overweight and obesity) in the Samliam municipal elementary students. A significant relationship between high height for age and dental caries was found.*

***Keywords:*** *Dental caries, Nutritional status, Elementary students*

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Nutrition is an essential component in human growth, development and maintenance of healthy life[1]. Pediatric malnutrition is defined as an imbalance between nutrient requirements and intake that results in cumulative deficits of energy, protein, or micronutrients that may negatively affect growth, development, and other relevant outcomes[2]. Malnutrition includes both undernutrition and overnutrition. Undernutrition is the result of insufficient intake, poor absorption, and/or poor biological use of the nutrients. This can result in impaired body functions, impaired growth, and underweight. Over nutrition is the result of excess or imbalanced nutrient intakes, which can result in impaired body functions, as well as overweight or even obesity[3]. The recent National Nutrition Survey in 2011, Thailand has demonstrated that prevalence of childhood (aged 6.0 to 12.9 years) obesity is higher in urban (11.8%) than in rural areas (7.3%)[4]. Rojroong Wasinkul et al, in 2013, revealed a prevalence of obesity up to 16.3% in Thai children aged 6.0 to 12.9 years. The prevalence of stunting in rural children (8.3%) was twice as high as that in urban children (4.3%)[5].

Dental caries is an irreversible microbiologic disease of calcified tissues of teeth characterized by demineralization of inorganic portion and destruction of the organic substance of the tooth which often leads to cavitation[6]. Dental caries has historically been considered an important component of the global disease burden, particularly in developing countries. In Thailand, the data of 7th National Dental Health Survey conducted in 2012 showed 78.5% of the 5-year-old children, 52.3% of the 12-year-old children were affected by dental caries[7].

Both malnutrition and dental caries are important health issues with multifactorial aspects. A review of the possible effects of dental caries on failure

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to thrive (FTT) showed that in healthy children, severe dental decay could contribute to FTT[8]. Dental caries among 6 to 12 years old children in Bangladesh was found to be associated with underweight[9]. Untreated caries could affect children's ability to eat and, subsequently impairs adequate intake of nutrients[10]. Furthermore, the 12-year-old children with dental infections in permanent teeth had significantly below normal body mass index (BMI)[12].

The period from childhood to adolescence is a critical stage of life. Adequate knowledge about healthy food choices and food safety can be predisposing factors for improving eating habits and adopting a good healthy diet. Motivating children to adopt healthy eating habits is essential[13]. Roles of teachers, parents and dental personnel in the promotion of dietary education in schools are extremely important.

The Samliam municipal school, Khon Kaen Province is an elementary school under the Universal Coverage Health Insurance Scheme (UC) of Faculty of Dentistry, Khon Kaen University. The present study aimed to explore the relationship between nutritional status and dental caries in Samliam municipal students, Khon Kaen Province. Findings from the present study may benefit the students by developing preventive planning to reduce dental caries and malnutrition among the students.

## Material and Method

### *Study design and subjects*

This cross-sectional study was conducted between March to August, 2015. A total of 210 Samliam municipal elementary students volunteered to participate in this present study. Stratified random sampling method was used for the selection of the sample. The stratum of this study was school classes, and then simple random sampling was performed from each stratum.

### *Ethics approval*

All the participants were voluntary and written informed consent were obtained before the beginning of the study. The current study was approved by the Khon Kaen University Ethics Committee for Human Research, based on the stipulations of the Declaration of Helsinki and the ICH Good Clinical Practice Guidelines (HE 571483).

### *Assessment of nutritional status*

All anthropometric measures were performed. Body weight was measured to the nearest 0.1 kg with a digital scale. The height was measured to the nearest 0.1 cm with a portable measuring unit. BMI was calculated as weight (in kilograms)/height (in meters) squared. The standard deviation scores (z-scores) of weight, height and BMI were derived using the age and gender specific WHO growth references for 5 to 19 years[14]. Interpretation of BMI for age z-scores included: 1) <-2 SD for thinness; 2) $\geq$-2 to <1 SD for normal; 3) $\geq$1 to $\leq$2 SD for overweight; 4) >2 SD for obesity. Malnutrition status was assessed using the following indicators: 1) weight for age z-scores <-2 SD for underweight; 2) height for age z-scores <-2 SD for stunting; and 3) BMI for age z-scores <-2 SD for thinness; $\geq$1 to $\leq$2 SD for overweight; and >2 SD for obesity.

### *Dental caries assessment*

An oral examination was carried out under natural light using plane mouth mirrors, World Health Organi-zation (WHO) probes, and explorers. The sterilization of instruments was done by autoclave method. No radiographs were taken. Dental caries was registered using the dmf and DMF indexes according to the WHO codes and criteria[15]. Plaque score was measured using Plaque Index[16].

### *Reproducibility of oral indices*

Two researchers were trained to examine oral status, covering the status of any dental caries and dental plaque. The reproducibility of researchers was assessed. The intra-examiner kappa value for DMFT Index and Plaque Index was 1.0 and 0.8, respectively. The inter-examiner kappa value for DMFT Index and Plaque Index was 0.8 and 0.7, respectively.

### *Questionnaires*

A questionnaire was sent to the children and their parent to fill out. The questionnaire was designed to collect information on: (a) socio-demographic characteristics; (b) child's oral health care; (c) child's daily eating habits; and (d) dental care over the previous 6-month period.

### *Data analyses*

A descriptive analysis was performed. Results are hereafter presented as percentages or means $\pm$ SD. Bivariate relationships between dental caries with potential predictors, were assessed using Chi-square test. The final model of multivariable logistic regression (stepwise method) was used to explore the relationship between nutritional status and dental caries in Samliam

municipal students, Khon Kaen Province. A *p*-value of less than 0.05 was considered statistically significant.

## Results

The average age of the participants was 9.3±1.7 years (range, 6 to 12) with girls predominantly (62.9%). The most common educational level of the children were Grade 5 (20.05%), Grade 4 (19.0%) and Grade 1 (18.6%), respectively. The most common education level of the caregivers or parents was secondary school (36.7%). The highest family income (baht/month) was 5,001 to 10,000 (39.0%).

The majority of the participants had normal nutritional status (65.2%). The underweight children (weight for age, z score <-2SD) was 3.3% whilst the stunting children (height for age, z-scores <-2 SD) was 3.8% (Fig. 1).

The prevalence rate of dental caries was 73.4% (95% CI = 70.8 to 86.6). Decay, missing and filling of deciduous teeth (dmft) were 3.1±3.6 teeth/person. Decay, missing and filling of permanent teeth (DMFT) were of 0.4±2.9 teeth/person (Table 1).

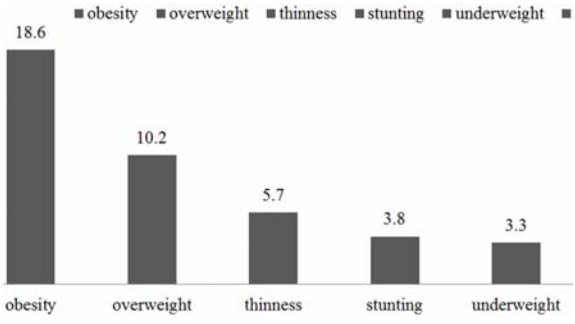


**Fig. 1** The prevalence rate of malnutrition in Samliam municipal students (n = 210).

Multivariable logistic regression and bivariable analyses showed that factors related to dental caries in these samples were previous fluoride intake and height for age with statistically significance at *p*-value <0.05. The children who had previously received fluoride had dental caries to a lesser degree than those who did not by adjusted odds ratio = 0.11 (0.014 to 0.8). The children with relatively tall and tall had fewer dental caries than those with normal height by adjusted odds ratio = 0.33 (0.13 to 0.8) (Table 2 and 3).

## Discussion

This current study revealed the relationship between nutritional status and dental caries in Samliam municipal students, Khon Kaen Province. The Samliam municipal school is a school under the universal coverage health insurance scheme (UC) of Faculty of Dentistry, Khon Kaen University. All children are entitled for free dental services. Dental personnel provide a comprehensive benefit package, covering oral health promotion, prevention and dental health services for these school children.

In this present study, educational level and family income of the majority of participating parents or caregivers were low. In 2010, Babar et al studied among primary school students from Pakistan and reported that poverty, low literacy rate, large families, food insecurity, women's education appeared to be the important underlying factors responsible for poor health status of the children from low socioeconomic class[17].

The present study revealed that the prevalence of overweight and obesity were higher than a survey in the Thai children aged 3 to 18 years in

**Table 1.** Mean DMFT, mean dmft, prevalence rate of dental caries in the participating children by educational level in Samliam municipal students

| Educational level | Total | dmft[a] (teeth/person) | DMFT[b] (teeth/person) | Prevalence rate of dental caries (95%CI) |
|---|---|---|---|---|
| Grade 1 | 39 | 5.8±4.3 | 0.4±0.7 | 84.6 (72.7-96.0) |
| Grade 2 | 29 | 4.8±3.8 | 0.06±0.2 | 93.1 (83.2-100.0) |
| Grade 3 | 32 | 3.7±3.5 | 0.6±1.2 | 71.9 (55.4-88.3) |
| Grade 4 | 40 | 2.2±2.3 | 0.2±0.5 | 75.0 (60.9-89.0) |
| Grade 5 | 43 | 1.1±1.8 | 0.7±1.3 | 65.1 (50.2-79.9) |
| Grade 6 | 27 | 0.5±1.1 | 0.6±0.7 | 55.1 (35.5-75.5) |
| Total | 210 | 3.1±3.6 | 0.4±2.9 | 73.4 (70.8-86.6) |

[a] = Decay, missing and filling of deciduous teeth, [b] = Decay, missing and filling of permanent teeth

**Table 2.** Factors related with dental caries in the participating students by bivariable analyses

| Variables | Dental caries | | | $\chi^2$ | *p*-value |
|---|---|---|---|---|---|
| | Caries free (dmft/DMFT = 0) n (%) | Caries (dmft/DMFT ≥1) n (%) | Total (n = 210) | | |
| Gender | | | | | |
| Boys | 16 (20.5) | 62 (79.5) | 78 | 0.19 | 0.122 |
| Girls | 38 (28.8) | 94 (71.2) | 132 | | |
| The students' educational level | | | | | |
| Grade 1 | 6 (15.4) | 33 (84.6) | 39 | 14.5 | 0.013* |
| Grade 2 | 2 (6.9) | 27 (93.1) | 29 | | |
| Grade 3 | 9 (28.1) | 23 (71.9) | 32 | | |
| Grade 4 | 10 (25.0) | 30 (75.0) | 40 | | |
| Grade 5 | 15 (34.9) | 28 (65.1) | 43 | | |
| Grade 6 | 12 (44.4) | 15 (55.6) | 27 | | |
| The caregiver's educational level | | | | | |
| Primary school | 19 (27.5) | 50 (72.5) | 69 | 0.20 | 0.976 |
| Secondary school | 19 (24.7) | 58 (75.3) | 77 | | |
| Vocational certificate | 12 (25.5) | 35 (74.5) | 47 | | |
| Bachelor's degree | 4 (23.5) | 13 (76.5) | 17 | | |
| Family income (baths/month) | | | | | |
| 0-5,000 | 9 (40.9) | 13 (59.1) | 22 | 5.71 | 0.221 |
| 5,001-10,000 | 16 (19.5) | 66 (80.5) | 82 | | |
| 10,001-15,000 | 10 (21.7) | 36 (78.3) | 46 | | |
| 15,001-20,000 | 7 (25.9) | 20 (74.1) | 27 | | |
| >20,000 | 12 (36.4) | 21 (63.6) | 33 | | |
| Received fluoride | | | | | |
| Never | 1 (4.3) | 22 (95.7) | 23 | 6.77 | 0.034* |
| Do not know | 5 (21.7) | 18 (78.3) | 23 | | |
| Ever | 48 (29.3) | 116 (70.7) | 164 | | |
| Frequent between meals consumption | | | | | |
| Beverage intake | | | | | |
| Yes | 26 (24.3) | 81 (75.7) | 107 | 0.22 | 0.374 |
| No | 28 (27.2) | 75 (72.8) | 103 | | |
| Snack intake | | | | | |
| Yes | 23 (25.3) | 68 (74.7) | 91 | 0.01 | 0.514 |
| No | 31 (26.1) | 88 (73.9) | 119 | | |
| Candy intake | | | | | |
| Yes | 16 (29.6) | 38 (70.4) | 54 | 0.58 | 0.277 |
| No | 38 (24.4) | 118 (75.6) | 156 | | |
| Fruit intake | | | | | |
| Yes | 24 (21.2) | 89 (78.8) | 113 | 2.56 | 0.075 |
| No | 30 (30.9) | 67 (69.1) | 97 | | |
| Tooth brushing | | | | | |
| Sometimes | 8 (23.5) | 26 (76.5) | 34 | 0.36 | 0.834 |
| Twice per day | 13 (23.6) | 42 (76.4) | 55 | | |
| >twice per day | 33 (27.3) | 88 (72.7) | 121 | | |
| Plaque index | | | | | |
| 0-1.0 | 27 (31.0) | 60 (69.0) | 87 | 2.29 | 0.318 |
| 1.0-2.0 | 25 (22.3) | 87 (77.7) | 112 | | |
| >2.0 | 2 (18.2) | 9 (81.8) | 11 | | |

* Statistical significance at $p<0.05$

**Table 2.** Cont.

| Variables | Dental caries | | | $\chi^2$ | *p*-value |
|---|---|---|---|---|---|
| | Caries free (dmft/DMFT = 0) n (%) | Caries (dmft/DMFT ≥1) n (%) | Total (n = 210) | | |
| BMI for age | | | | | |
| Thinness | 4 (33.3) | 8 (66.7) | 12 | 3.02 | 0.388 |
| Normal weight | 30 (21.9) | 107 (78.1) | 137 | | |
| Overweight | 7 (31.8) | 15 (68.2) | 22 | | |
| Obesity | 13 (33.3) | 26 (66.7) | 39 | | |
| Weight for age | | | | | |
| Relatively underweight and underweight | 9 (34.6) | 17 (65.4) | 26 | 6.24 | 0.044* |
| Normal weight | 28 (20.3) | 110 (79.7) | 138 | | |
| Overweight and obesity | 17 (37.0) | 29 (63.0) | 46 | | |
| Height for age | | | | | |
| Relatively short and stunting | 1 (5.0) | 19 (95.0) | 20 | 10.40 | 0.005* |
| Normal height | 42 (25.1) | 125 (74.9) | 167 | | |
| Relatively tall and tall | 11 (47.8) | 12 (52.2) | 23 | | |

* Statistical significance at $p<0.05$

**Table 3.** Factors related with dental caries in the participating students by multiple logistic regression (stepwise method)

| Variables | Dental caries | | | Crude odds ratio (95% CI) | Adjusted odds ratio (95% CI) |
|---|---|---|---|---|---|
| | Caries freen (%) (dmft/DMFT = 0) | Caries n (%) (dmft/DMFT ≥1) | Total (n = 210) | | |
| Received fluoride | | | | | |
| Never | 1 (4.3) | 22 (95.7) | 23 | 1 | 1 |
| Do not know | 5 (21.7) | 18 (78.3) | 23 | 0.16 (0.01-1.5) | 0.18 (0.02-1.8) |
| Ever | 48 (29.3) | 116 (70.7) | 164 | 0.1 (0.01-0.8) | 0.11 (0.014- 0.8)* |
| Height for age | | | | | |
| Normal height | 42 (25.1) | 125 (74.9) | 167 | 1 | 1 |
| Relatively short and short | 1 (5.0) | 19 (95.0) | 20 | 6.3 (0.8-49.1) | 5.9 (0.76-46.2) |
| Relatively tall and tall | 11 (47.8) | 12 (52.2) | 23 | 0.36 (0.15-0.9) | 0.33 (0.13-0.8)* |

* Statistical significance at $p<0.05$ after adjusted age, gender, child educational level, caregiver's education, family income, tooth brushing, plague index, between meal consumption, weight for age and BMI for age

2011[18] and a study of urban Thai children aged 6.0 to 12.9 years in 2013[5]. However, the prevalence of stunting, underweight and thinness of the participants in this presents study was less than previous studies[4,5]. The present study shows a high prevalence of childhood obesity (18.6%) coexisting with low prevalence of underweight (3.3%), stunting (3.8%) and thinness (5.7%). It is well documented that suffering from undernutrition or overnutrition during the school years can inhibit a child's physical and mental development[19]. Childhood obesity may lead to serious complications, a decrease in life expectancy and numerous other health problems. These children also face increased risks of high blood pressure, metabolic

syndrome, non-insulin-dependent (type 2) diabetes, and psychological disorders[19]. Stunting (low height for age) is associated with long-term consequences, such as impaired intellectual achievement and school performance[20], and also leads to reduction in adult body size and, subsequently, reduced work capacity and obstetric complications[20]. Thinness (low body mass index; BMI for age) in school-age children can result in delayed maturation, deficiencies in muscular strength and work capacity, and reduced bone density later in life[21]. Both over nutrition and undernutrition are important public health problems. Proper strategies to alleviate the immediate and long-term malnutrition in Samliam municipal students are crucial and needed.

The prevalence rate of dental caries in the children aged 6 to 7 years in this present study (84.6%) was higher than the children aged 5 to 6 years in the seventh national oral health survey in Thailand[7]. These ages were of interest in relation to levels of caries in the primary dentition. So, this result showed that dental caries in primary teeth in this school was high. Otherwise, Mean of DMFT Index in the children with aged 12 years in this present study (DMFT = 0.4±0.9 teeth/person) was less than a survey of the children aged 12 years in the seventh national oral health survey, Thailand[7]. This may possibly be explained by the fact that during five years in the school, the children received oral health promotion, regular dental examinations, adequate fluoride supplementation and dental services from Faculty of Dentistry, Khon Kaen University.

There was no relationship between BMI for age and dental caries prevalence in this present study. It was in agreement with the findings of some studies, which had reported a weak or no relationship between body mass index (BMI) and dental caries[22,23]. A systematic review by Hayden et al indicates that when standardized definitions for the assessment of child obesity were used, a small overall relationship between obesity and level of caries in the permanent dentition was encountered: caries were more prevalent in obese children than in normal weight children. In addition, they found no relationship between obesity and caries in primary dentition[24], whilst other studies had reported a positive relationship between dental caries and BMI. Overweight or obese children have a greater likelihood of suffering dental caries than those of normal weight[25-26].

Moreover, this present study showed that height for age was related to dental caries. The children who were relatively tall had dental caries to a lesser degree than children with normal height by adjusted odds ratio = 0.33, (95% CI = 0.13 to 0.8). It was similar to a study in Brazilian adolescents, in 2008 which revealed that a decreased risk of having higher DMFS levels was found among the tallest adolescents aged 15 years by adjusted odds ratio = 0.55, 95% CI = 0.36 to 0.83)[27]. A study among Brazilian adolescents aged 13 years in 2005 showed that taller individuals had lower caries severity in the permanent dentition after adjusting for other demographic and social variables[28]. However, this present study demonstrated that the children who received fluoride had dental caries less than those who did not by adjusted odds ratio = 0.11(0.014 to 0.8). Fluoride is highly effective in preventing dental caries. Tubert-Jeannin et al reviewed that the use of fluoride supplements was associated with a reduction in caries increment when compared with no fluoride supplement in permanent teeth[29].

Children, especially those in elementary schools, need a sufficient amount of energy to support their activities during the day. Their nutrition and lifestyle highly affect well-being, growth and development. The prevalence of childhood obesity in Samliam municipal students is high. Sirikulchayanonta et al revealed that Thai children had drastically changed their behaviors. They consumed more fatty foods, high-caloric and sweetened foods[30]. Unhealthy foods and sedentary behavior contribute to obesity in children[31]. Malnutrition and dental caries can be addressed efficiently early in life. 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 parents, teachers and dental personnel 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 study design has a limitation to infer a causal relationship between nutritional status and dental caries. Conducting a longitudinal study would have provided stronger evidence on the temporal relationship between nutritional status and dental caries.

**Conclusion**

There were a high prevalence of deciduous dental caries and malnutrition (overweight and obesity) in the school-age children. A significant relationship between high height for age and dental

caries was found.

**What is already known on this topic?**

There was a relationship between underweight and dental caries in elementary students in Thailand.

**What this study adds?**

This present study showed high prevalence of obesity and deciduous dental caries in Samliam municipal students, which is crucial and needs to be prevented.

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**Potential conflicts of interest**

None

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## *ความสัมพันธ์ระหว่างภาวะโภชนาการกับฟันผุในเด็กนักเรียนชั้นประถมศึกษา โรงเรียนเทศบาลสามเหลี่ยม จังหวัดขอนแก่น*

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***ภูมิหลังและวัตถุประสงค์:*** *ภาวะทุพโภชนาการและโรคฟันผุเป็นปัญหาที่สำคัญในเด็กนักเรียนประถมศึกษา ประเทศไทย วัตถุประสงค์ของการศึกษานี้คือศึกษาความสัมพันธ์ระหว่างภาวะโภชนาการกับฟันผุในเด็กนักเรียนชั้นประถมศึกษาโรงเรียนเทศบาลสามเหลี่ยม จังหวัดขอนแก่น*

***วัสดุและวิธีการ:*** *การศึกษาแบบตัดขวางนี้ดำเนินการในช่วงเดือนมีนาคม ถึง สิงหาคม พ.ศ. 2558 มีเด็กนักเรียนชั้นประถมศึกษา โรงเรียนเทศบาลสามเหลี่ยม สมัครใจเข้าร่วมในการศึกษานี้ทั้งหมด 210 คน เก็บรวบรวมข้อมูลจากแบบสอบถาม ชั่งน้ำหนัก วัดส่วนสูงและแบบบันทึกการตรวจสุขภาพช่องปาก บันทึกสภาวะสุขภาพช่องปากโดยใช้ดัชนีวัดฟันผุ ฟันถอน และฟันผุ (DMFT) และดัชนีวัดแผ่นคราบจุลินทรีย์ วัดภาวะโภชนาการโดยใช้ดัชนีมวลกายตามเกณฑ์อายุจากเกณฑ์องค์การอนามัยโลกปี พ.ศ. 2550 น้ำหนักตามเกณฑ์อายุ และ ส่วนสูงตามเกณฑ์อายุ*

***ผลการศึกษา:*** *กลุ่มตัวอย่างมีอายุเฉลี่ย 9.3±1.7 ปี (ต่ำสุด 6 ปี ถึง สูงสุด 12 ปี) อัตราความชุกโรคฟันผุเท่ากับร้อยละ 73.4 ค่าเฉลี่ยฟันผุถอนอุดในฟันน้ำนมเท่ากับ 3.1±3.6 ซี่/คน ค่าเฉลี่ยฟันผุถอนอุดในฟันแท้เท่ากับ 0.4±2.9 ซี่/คน ภาวะโภชนาการเมื่อวัดโดยใช้ค่าดัชนีมวลกายตามเกณฑ์อายุ พบว่าเด็กนักเรียนมีภาวะโภชนาการปกติร้อยละ 65.2 ผอมร้อยละ 5.7 น้ำหนักเกิน ร้อยละ 10.2 และอ้วนร้อยละ 18.6 การศึกษานี้พบว่ามีความสัมพันธ์ระหว่างส่วนสูงตามเกณฑ์อายุที่สูงกับโรคฟันผุอย่างมีนัยสำคัญ*

***สรุป:*** *เด็กนักเรียนชั้นประถมศึกษาโรงเรียนเทศบาลสามเหลี่ยมมีความชุกของฟันน้ำนมผุและภาวะทุพโภชนาการ(น้ำหนักเกินและอ้วน)สูง พบความสัมพันธ์ระหว่างส่วนสูงตามเกณฑ์อายุที่สูงกับโรคฟันผุอย่างมีนัยสำคัญ*