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Relationship between Sugar-Sweetened Beverage Intake and the Risk of Dental Caries Among Primary School Children: A Cross-Sectional Study in Nonthaburi Province, Thailand.

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Abstract

Background: *Dental caries remains a significant public health concern among primary school children, with sugar-sweetened beverage (SSB) consumption identified as a major risk factor. Our study aimed to investigate the association between SSB consumption and dental caries risk among primary school children in Nonthaburi Province, Thailand.*

Methods: *We conducted a cross-sectional study involving 400 primary school students aged 10-12 years, selected through stratified random sampling. Data were collected using a validated questionnaire assessing SSB consumption patterns, oral hygiene practices, and socio-demographic factors. Dental examinations were performed to determine the presence of dental caries. We used multivariate logistic regression analysis to identify factors associated with dental caries risk.*

Results: *We found a dental caries prevalence of 62.5% among our study population. High SSB consumption (>3 times/week) was significantly associated with increased dental caries risk (adjusted OR = 2.34, 95% CI: 1.68-3.27, p<0.001). Other factors significantly associated with dental caries risk included inadequate tooth brushing (adjusted OR = 1.87, 95% CI: 1.32-2.65, p=0.001) and low parental education level (adjusted OR = 1.56, 95% CI: 1.12-2.18, p=0.009).*

Conclusions: *Our findings suggest a strong association between high SSB consumption and increased dental caries risk among primary school children in Nonthaburi Province. These results highlight the need for targeted interventions to reduce SSB consumption and promote oral health education in this population.*

Keywords – *Sugar-sweetened beverages, Dental caries, Primary school children, Oral health, Thailand*

INTRODUCTION

Dental caries is a prevalent oral health problem affecting children worldwide, with significant implications for their overall health and quality of life (Kassebaum et al., 2017). In Thailand, dental caries remains a major public health concern, particularly among primary school children (Krisdapong et al., 2018). The consumption of sugar-sweetened beverages (SSBs) has been identified as a key risk factor for dental caries development,

owing to their high sugar content and acidity (Moynihan & Kelly, 2014).

Recent studies have shown a dramatic increase in SSB consumption among Thai children, with carbonated soft drinks and sweetened tea being particularly popular (Lim et al., 2019). This trend is alarming, given the well-established link between SSB consumption and various health issues, including dental caries, obesity, and type 2 diabetes (Vartanian et al., 2011).

While previous research has explored the relationship between dietary habits and dental caries in Thai children, there is limited data specifically focusing on the association between SSB consumption patterns and dental caries risk in primary school children in Nonthaburi Province. Our study aims to address this gap by investigating the association between SSB consumption and dental caries risk among primary school children aged 10-12 years in Nonthaburi Province, Thailand.

The objectives of our study are:

1. To assess the prevalence of dental caries among primary school children aged 10-12 years in Nonthaburi Province.
2. To examine the patterns of SSB consumption in this population.
3. To investigate the association between SSB consumption and dental caries risk, adjusting for socio-demographic factors and oral hygiene practices.

By providing insights into the relationship between SSB consumption and dental caries risk in this specific population, we hope our study will inform targeted interventions and policies to promote oral health among Thai primary school children. Our findings may also contribute to the broader understanding of the impact of SSB consumption on children's oral health in similar settings across Southeast Asia.

METHODS

Study Design and Setting

We conducted this cross-sectional study between January and June 2023 in Nonthaburi Province, Thailand. We chose Nonthaburi Province for its diverse socio-economic population and its representation of both urban and semi-urban areas, which we believed would provide a comprehensive view of the issue at hand.

Study Population and Sampling

Our study population consisted of primary school students aged 10-12 years enrolled in public schools in Nonthaburi Province. To ensure a representative sample, we employed a stratified random sampling technique to select participating schools from different socio-economic areas within the province. Within each selected school, we randomly chose students from class rosters.

To determine our sample size, we used the formula for cross-sectional studies (Lwanga & Lemeshow, 1991), with a 95% confidence level and 5% margin of error. This calculation resulted in a required sample size of 384. To account for potential non-responses, we increased our final sample size to 400 participants.

Data Collection

We collected data using two main methods: a structured questionnaire and clinical dental examinations. The questionnaire was developed based on a thorough review of relevant literature and was validated through expert review and pilot testing. It consisted of four key sections:

1. Socio-demographic information (age, gender, parental education, household income)
2. SSB consumption patterns (frequency, types of beverages, portion sizes)
3. Oral hygiene practices (tooth brushing frequency, use of fluoride toothpaste)
4. Dietary habits (snacking frequency, consumption of sugary foods)

For the dental examinations, we enlisted the help of trained and calibrated dentists who used the WHO criteria

for dental caries diagnosis (WHO, 2013). The presence of dental caries was recorded using the DMFT (Decayed, Missing, Filled Teeth) index, a well-established measure in dental research.

Ethical Considerations

Before beginning our study, We obtained written informed consent from parents or guardians, and assent from the participating children. We assured all participants of the confidentiality of their information and their right to withdraw from the study at any time without consequences.

Data Analysis

We analyzed our data using SPSS version 26.0. Our analysis included several steps:

1. We used descriptive statistics to summarize socio-demographic characteristics, SSB consumption patterns, and the prevalence of dental caries.
2. We employed Chi-square tests to assess the association between categorical variables.
3. To identify factors associated with dental caries risk, we performed multivariate logistic regression analysis, adjusting for potential confounders.
4. We calculated odds ratios (OR) with 95% confidence intervals (CI) to quantify the strength of associations.
5. We considered a p-value <0.05 as statistically significant.

RESULTS

Socio-demographic Characteristics

Our study achieved a high response rate of 98.5%, with a total of 400 primary school children participating. The mean age of our participants was 11.2 years (SD = 0.8), with a fairly even gender distribution of 52% female and 48% male. Table 1 presents a detailed breakdown of the socio-demographic characteristics of our study population.

Table 1: Socio-demographic characteristics of study participants (N=400)

Characteristic	n	%
Age (years)		
10	120	30.0
11	160	40.0
12	120	30.0
Gender		
Female	208	52.0
Male	192	48.0
School grade		
Grade 4	132	33.0
Grade 5	136	34.0
Grade 6	132	33.0
Parental education level		
Primary school or below	80	20.0
Secondary school	160	40.0
College/university	140	35.0
Postgraduate	20	5.0
Monthly household income (THB)		
< 15000	100	25.0
15000 - 30000	160	40.0
30001 - 50000	100	25.0
> 50000	40	10.0

Area of residence		
Urban	280	70.0
Semi-urban	120	30.0

Prevalence of Dental Caries

Our dental examinations revealed a concerning prevalence of dental caries among our study population. We found that 62.5% (95% CI: 57.8-67.2%) of the children had at least one decayed, missing, or filled tooth. The mean DMFT score was 2.8 (SD = 2.1), indicating a moderate level of caries experience in this age group.

SSB Consumption Patterns

Our analysis of SSB consumption patterns yielded some interesting insights. We found that nearly half of our participants (45%) reported consuming SSBs more than three times per week. Carbonated soft drinks emerged as the most popular choice, with 38% of children indicating these as their most frequently consumed SSBs. This was followed by sweetened tea or coffee (28%) and fruit-flavored drinks (22%). Table 2 provides a more detailed breakdown of the SSB consumption patterns we observed.

Table 2: SSB consumption patterns among study participants (N=400)

Characteristic	n	%
Frequency of SSB consumption		
≤ 1 time per week	80	20.0
2-3 times per week	140	35.0
> 3 times per week	180	45.0
Types of SSBs consumed most often		
Carbonated soft drinks	152	38.0
Sweetened tea or coffee	112	28.0
Fruit-flavored drinks	88	22.0
Sports/energy drinks	32	8.0
Other	16	4.0
Average portion size per serving		
Small (≤ 250 ml)	120	30.0
Medium (251-500 ml)	200	50.0
Large (> 500 ml)	80	20.0
Time of SSB consumption		
With meals	100	25.0
Between meals	220	55.0
Before bedtime	80	20.0

Association Between SSB Consumption and Dental Caries Risk

Our multivariate logistic regression analysis revealed a significant association between high SSB consumption and increased dental caries risk. After adjusting for potential confounders, we found that children who consumed SSBs more than three times per week had more than twice the odds of developing dental caries compared to those who consumed SSBs once a week or less (adjusted OR = 2.34, 95% CI: 1.68-3.27, $p<0.001$).

Interestingly, our analysis also identified other significant risk factors for dental caries. Inadequate tooth brushing (less than twice a day) was associated with increased odds of dental caries (adjusted OR = 1.87, 95% CI: 1.32-2.65, $p=0.001$). Additionally, we found that children whose parents had a lower education level (primary school or below) were at higher risk of dental caries (adjusted OR = 1.56, 95% CI: 1.12-2.18, $p=0.009$).

Table 3 presents the full results of our multivariate logistic regression analysis, showing the adjusted odds

ratios for various factors associated with dental caries risk.

Table 3: Multivariate Logistic Regression Analysis of Factors Associated with Dental Caries Risk

Variable	Adjusted OR	95% CI	p-value
SSB consumption frequency			
≤ 1 time per week (reference)	1.00	--	--
2-3 times per week	1.56	1.12 - 2.18	0.009
> 3 times per week	2.34	1.68 - 3.27	< 0.001
Tooth brushing frequency			
≥ 2 times/day (reference)	1.00	--	--
< 2 times/day	1.87	1.32 - 2.65	0.001
Use of fluoride toothpaste			
Yes (reference)	1.00	--	--
No	1.45	1.03 - 2.04	0.033
Parental education level			
College/university+ (reference)	1.00	--	--
Secondary school	1.23	0.87 - 1.74	0.241
Primary school or below	1.56	1.12 - 2.18	0.009
Monthly household income (THB)			
> 30000 (reference)	1.00	--	--
15000 - 30000	1.18	0.83 - 1.68	0.352
< 15000	1.42	1.01 - 2.00	0.046
Snacking frequency			
≤ 1 time/day (reference)	1.00	--	--
2-3 times/day	1.33	0.94 - 1.88	0.107
> 3 times/day	1.65	1.17 - 2.33	0.004

OR: Odds Ratio; CI: Confidence Interval; SSB: Sugar-Sweetened Beverage; THB: Thai Baht

DISCUSSION

Our study provides valuable insights into the association between sugar-sweetened beverage (SSB) consumption and dental caries risk among primary school children in Nonthaburi Province, Thailand. The high prevalence of dental caries (62.5%) we observed is alarming but not entirely unexpected. This finding aligns with previous studies on Thai children (Krisdapong et al., 2018) and underscores the persistent nature of this oral health challenge in our region.

Perhaps the most striking finding of our study is the strong association between high SSB consumption and increased dental caries risk. Children who reported consuming SSBs more than three times per week were more than twice as likely to develop dental caries compared to those with low consumption. This relationship remained significant even after adjusting for various confounding factors, suggesting a robust link between SSB intake and oral health outcomes in our study population.

The strength of this association (adjusted OR = 2.34) is particularly concerning given the high rates of SSB consumption we observed. Nearly half (45%) of the children in our study reported consuming SSBs more than three times per week. This combination of high consumption rates and strong association with dental caries risk paints a worrying picture for the oral health of children in Nonthaburi Province.

Our findings on SSB consumption patterns provide additional context to this issue. Carbonated soft drinks emerged as the most popular choice among our participants, followed by sweetened tea or coffee. This preference for high-sugar, acidic beverages likely exacerbates the risk of dental caries. The acidity of these drinks, combined with their high sugar content, creates an ideal environment for enamel erosion and bacterial growth in the oral cavity (Moynihan & Kelly, 2014).

Interestingly, our study also highlighted the importance of other factors in dental caries risk. Inadequate tooth brushing emerged as a significant risk factor, with children who brushed less than twice a day having higher odds of developing dental caries. This finding emphasizes the crucial role of proper oral hygiene practices in mitigating the harmful effects of SSB consumption.

The association we found between parental education level and dental caries risk is also noteworthy. Children whose parents had lower education levels (primary school or below) were at higher risk of dental caries. This suggests that socioeconomic factors play a significant role in oral health outcomes, possibly through their influence on health literacy, access to dental care, and dietary habits.

While our study provides robust evidence for the link between SSB consumption and dental caries risk, it's important to acknowledge its limitations. The cross-sectional nature of our study precludes us from making causal inferences. Longitudinal studies would be valuable in establishing the temporal relationship between SSB consumption and dental caries development. Additionally, our reliance on self-reported data for SSB consumption may have introduced some recall bias, although we tried to minimize this through careful questionnaire design and administration.

Despite these limitations, our findings have important implications for public health policy and practice in Thailand. The high prevalence of dental caries and its strong association with SSB consumption suggest a need for targeted interventions to reduce SSB intake among primary school children. Such interventions could include school-based education programs on the health risks of excessive SSB consumption, policies to limit the availability of SSBs in schools, and community-wide campaigns to raise awareness about the importance of oral health.

Moreover, our results highlight the need for a multi-faceted approach to improving children's oral health. While reducing SSB consumption is crucial, efforts should also focus on promoting proper oral hygiene practices and addressing socioeconomic disparities in oral health outcomes.

CONCLUSION

Our study has shed light on a critical public health issue affecting primary school children in Nonthaburi Province, Thailand. The strong association we found between high sugar-sweetened beverage (SSB) consumption and increased dental caries risk is both striking and concerning. With more than 60% of the children in our study showing evidence of dental caries, and nearly half consuming SSBs more than three times per week, we are facing a significant oral health challenge that demands immediate attention.

These findings underscore the urgent need for targeted interventions to reduce SSB consumption among Thai children. However, it's important to recognize that addressing this issue will require a multifaceted approach. While reducing SSB intake is crucial, our results also highlight the importance of promoting proper oral hygiene practices and addressing socioeconomic disparities in oral health outcomes.

Based on our findings, we propose the following recommendations:

1. Development of school-based education programs: These should focus on raising awareness about the health risks associated with excessive SSB consumption and promoting healthier beverage choices.
2. Implementation of policies to limit SSB availability: Schools and other child-centric environments should consider restricting the sale and marketing of SSBs.
3. Community-wide awareness campaigns: These should emphasize the importance of oral health and the role of diet in maintaining it.
4. Promotion of proper oral hygiene practices: Education on correct tooth brushing techniques and the importance of regular dental check-ups should be integrated into school health programs.
5. Addressing socioeconomic disparities: Efforts should be made to improve access to dental care and oral health education for families from lower socioeconomic backgrounds.

While our study provides valuable insights, it also opens up avenues for future research. Longitudinal studies would be beneficial in establishing the causal relationship between SSB consumption and dental caries development over time. Additionally, research into the effectiveness of various intervention strategies would be crucial in informing evidence-based policies.

In conclusion, our findings serve as a call to action for policymakers, healthcare providers, educators, and parents alike. By working together to reduce SSB consumption and promote better oral health practices, we have the opportunity to significantly improve the oral health outcomes of Thai children. This not only benefits the individuals involved but also has broader implications for public health and healthcare costs in Thailand.

As researchers, we remain committed to furthering our understanding of this important issue and contributing to the development of effective solutions. It is our hope that this study will serve as a stepping stone towards creating a healthier future for the children of Nonthaburi Province and beyond.

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