

## The association of snacking behavior and sodium intake with nutritional status in primary school children

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### ABSTRAK

**Latar Belakang:** Hubungan antara perilaku jajan dan status gizi belum dapat disimpulkan karena dapat disebabkan oleh perbedaan jumlah jajanan dan asupan natrium yang dikonsumsi.

**Tujuan:** Penelitian ini bertujuan untuk mengetahui hubungan kebiasaan jajan dan asupan natrium kaitannya dengan status gizi pada anak sekolah dasar.

**Metode:** Survei cross-sectional terhadap 115 anak usia 8-12 tahun dilakukan di Jakarta Selatan, Indonesia. Asupan makanan dinilai menggunakan recall 24 jam dan pengukuran antropometri dilakukan. Status gizi subjek ditentukan dengan menggunakan indikator IMT/usia.

**Hasil:** Anak-anak yang kurus mengkonsumsi makanan ringan dua kali lebih banyak daripada anak-anak yang gemuk, tetapi mengkonsumsi lebih sedikit energi yang bersumber dari makanan. Tidak ada perbedaan rata-rata konsumsi energi dari makanan dan dengan status gizi partisipan yang berbeda ( $p > 0,05$ ). Produk snack yang paling sering dikonsumsi oleh peserta adalah minuman manis, gorengan, dan snack ekstrudat. Rata-rata asupan natrium harian partisipan adalah  $1620,11 \pm 1129,780$  mg dan meningkat secara signifikan dengan peningkatan asupan energi ( $p\text{-trend} < 0,05$ ). Tidak ada hubungan antara status gizi dengan konsumsi natrium pada penelitian ini.

**Kesimpulan:** Meskipun kebiasaan jajan tidak berpengaruh pada status gizi, namun hal ini berkontribusi pada peningkatan asupan natrium. Temuan ini mungkin menyiratkan bahwa kandungan natrium dalam makanan ringan harus diatur lebih lanjut untuk mencegah perkembangan penyakit tidak menular.

**KATA KUNCI:** jajan; kebiasaan jajan; makanan ringan; asupan natrium; status gizi

### ABSTRACT

**Background:** The associations between snacking behavior and nutritional status are inconclusive, which may be due to differences in snacking quantity and sodium intake.

**Objectives:** This study aims to determine the association between snacking behavior and sodium intake and nutritional status in primary school children.

**Methods:** A cross-sectional survey of 115 children aged 8-12 years old was conducted in South Jakarta, Indonesia. Dietary intake was assessed using 24-hour recalls and anthropometric measurements were collected. The nutritional status of subjects was determined using BMI-for-age indicator.

**Results:** Thin children consume twice as many snacks as children who are obese but consume less energy at meals. The average energy consumption from meals and snacks was not significantly different between participants with varying nutritional status ( $p > 0.05$ ). Participants' snack products most frequently consumed were sugar-sweetened beverages, fried foods, and extruded snacks. The average daily sodium intake was  $1620.11 \pm 1129.780$  mg and increased significantly with increased energy intake ( $p\text{-trend} < 0.05$ ). There was no association between nutritional status and sodium consumption in this study.

**Conclusions:** While snacking have no effect on nutritional status, it contributes to increase sodium intake. This finding may imply that sodium content in snacks should be further regulated to prevent the development of non-communicable diseases.

**KEYWORD:** snacks, snack behavior, snacking, sodium intake, nutritional status

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## INTRODUCTION

Sodium is the main cation in the extracellular fluid. Excess sodium and insufficient potassium intake have been widely implicated as risk factors for stroke and heart disease development (1). According to a 2008 study conducted across six Southeast Asian countries, Indonesia had the highest prevalence of hypertension, while the Philippines had the highest mortality rate for cardiovascular disease and diabetes. Males had a prevalence of hypertension of 32.5 percent, while females had a prevalence of 29.3 percent (2). According to a 2016 report, more than a million people died in Indonesia due to non-communicable diseases (NCD), with cardiovascular disease (CVD) emerging as the leading cause. Sodium consumption is one of the numerous risk factors for NCD mortality (3). There were few studies on the direct effect of sodium on children. Previous studies reported that hypertension was more prevalent and severe in overweight / obese children (4). Therefore, the Ministry of Health Republic of Indonesia and the World Health Organization recommends a daily sodium intake of <2000mg/day to reduce the risk of hypertension, stroke, diabetes, and heart disease (5, 6).

Children who eat food at school can consume up to 50% of their daily caloric intake at school (7). Consumption of sweetened beverages, sweets, and snacks was positively associated with overweight status in a previous study (8). While some snacks are labeled as healthy, others are classified as nutrient-deficient and energy-dense foods, which have to be limited (9). In addition, snack consumption contributes to excessive intake (10). A urine sample taken from students aged 9-12 years revealed an excessive sodium intake (11). Most dietary sodium was obtained from added salt and sauces from food (12). In terms of location, store-bought foods accounted for 58% of sodium intake, fast-food/pizza restaurants accounted for 16%, and school cafeterias accounted for 10% (13).

There are few studies examining sodium intake concerning children's national status in our local setting. Most research on snacking behavior focuses exclusively on nutritional status, and the findings are inconsistent. Thus, the study aimed to assess dietary sodium intake and its association with nutritional status and snacking behavior among students aged 8 to 12 years. This study may contribute to developing strategies for reducing sodium consumption in primary school children.

## MATERIALS AND METHODS

### Participants

A cross-sectional study was conducted with primary school students aged 8-12 years old in a classroom setting. We sampled 115 primary school students, grades three to fifth, from SDN 05 Menteng Dalam and SDN 07 Menteng Dalam, South Jakarta, Indonesia, using a non probability sampling method (convenience sampling). Inclusion criteria were healthy children with physically active while the exclusion criteria were those who were sick and did not obtain parents consent.

### Data collection

Trained students from nutrition department were recruited to collect anthropometric data, 24 hours recall data, and demographic data. The demographic information (gender, age, and pocket money) was collected after the parents gave consent. A twenty-four-hour recall interview was used to identify foods and beverages, including snacks, consumed by the respondent in the past 24 hours. The weight was measured by calibrated digital scale to the nearest 0.1 kg and the height was measured by stadiometer to the nearest 0.1 cm. The digital weight measurement is calibrated routinely before use by nutrition department. Students wore light clothing and no shoes when

they were measured. Measurement and instrument calibration procedure according to CDC guideline (14). The body mass index (BMI) was calculated by multiplying the individual's weight in kilograms by the square of the height in meters. BMI/Age categorized nutritional status in primary school children with gender specifics referring to Ministry of Health (MOH) of Indonesia regulation (15). Energy adequacy level is classified as severe deficiency (<70% RDA), moderate deficiency (70-79.9% RDA), mild deficiency (80-89.9% RDA), normal (90-119.9% RDA), and excessive (120% RDA). Meals are defined as three traditional eating times such as breakfast (06.00-08.00), lunch (12.00-14.00), and dinner (19.00-20.00). Snack energy intake is calculated as the energy consumed from snacks and drinks rather than full meals consumed.

### Data Analyses

Categorical data are presented as percentages (%), while continuous variables are expressed as a mean±standard deviation. The Fisher exact test was used to determine associations between sodium intake on energy adequacy level and nutritional status. Spearman determined the correlation between pocket money and sodium consumption. According to energy adequacy levels, polynomial contrast in ANOVA was used to determine the p-trend in energy intake and sodium intake. All analyses were conducted using SPSS 24.

## RESULTS AND DISCUSSIONS

The characteristics of respondents are summarized in **Table 1**. A total of 115 students were collected, with the mean age of students being 10.68

± 1.06 years old. The proportions of boys (49.6%) and girls (50.4%) were comparable, and the majority of respondents have normal nutritional status (69.9%). In addition, almost 80% of pupils brought money than Rp 10.000, and it was positively related to the amount of sodium consumed (p=0.044). This finding is consistent with Li *et al.* (2017), who found students with greater pocket money consume sweetened drinks, fast food, street food, and fast food more frequently (16).

**Table 1. General characteristics of the respondent**

Variable	Number	Percentage %
Gender		
Boy	57	49.6
Girl	58	50.4
Grade		
3	27	23.5
4	28	24.3
5	60	52.2
Nutritional Status		
Severely thinness	2	1.8
Thinness	7	6.2
Normal	79	69.9
Overweight	18	15.9
Obese	7	6.2
Pocket Money (IDR)		
< 5.000	2	1.7
5.000 - 10.000	26	22.6
> 10.000	87	75.7

Despite differences in nutritional status among pupils, the average energy intake from meals and snacks was not significantly different (p>0.05). The total energy consumed per day was 2474.25±1082.29 kcal, with food accounting for up to 85.5% of energy and snacks accounting for up to 14.5%. The highest energy intake from meals was 2398.59 ± 563.10 kcal (89.88 ± 8.40%) for the

**Table 2. Energy intake from meals and snacks by participants based on their nutritional status**

Nutritional Status	Energy from Meals		Energy from Snacks	
	(kcal)	(%)	(kcal)	(%)
Severely thinness	1508.70 ± 1276.04	85.99 ± 15.27	140.00 ± 84.85	14.01 ± 15.27
Thinness	2076.06 ± 1031.92	79.30 ± 18.55	417.24 ± 324.58	20.70 ± 18.55
Normal	2162.73 ± 848.80	85.15 ± 12.85	402.46 ± 554.35	14.85 ± 12.85
Overweight	1898.19 ± 922.56	86.71 ± 11.53	336.83 ± 371.32	13.29 ± 11.53
Obese	2398.59 ± 563.10	89.88 ± 8.40	298.52 ± 265.43	10.12 ± 8.40
Total	2098.36 ± 866.98	85.50 ± 12.75	357.89 ± 494.29	14.50 ± 12.75

obese children, while the highest energy intake from snacks was  $417.24 \pm 324.58$  kcal ( $20.70 \pm 18.5\%$ ) for the thinness children (**Table 2**).

Sugar-sweetened beverages, fried foods, and extruded snacks were the most frequently consumed snack products by our participants, accounting for 37.75%, 26%, and 10.75%, respectively, contributing to the high energy density. These findings followed research conducted among children aged 6 to 13 years old, where additional snacking was associated with greater daily energy consumption (17). Even though most snacks are processed foods, they contribute less energy than processed ingredients and unprocessed foods consumed as meals (18). The traditional three-meal pattern has likely dominated among Indonesian children. Thus, this may reflect our finding that energy from snacks was less than energy from meals.

One interesting finding is that thin children consume twice as many snacks as obese children but consume the least energy from meals. This result corroborates the finding that schoolchildren who consume more snacks have a lower z score in height for age (HAZ) (19). This finding may be explained by the children experiencing satiety before entering their mealtime (20). In contrast, previous research found different results where nutritional status was associated with snacking habits (21, 22). Overweight individuals who were overeating have been stressed, eating rapidly, and consuming a high volume of snacks (20). Consuming high-energy, nutrient-deficient snacks and main meals may result in increased energy intake and subsequent weight gain (23). It can therefore be assumed that it is necessary to consider the nutrients contained in snacks as well as the quantity consumed.

**Table 3** shows the energy and sodium intake recalls based on energy adequacy levels. Over half of the participants consumed an excessive amount of energy. Moreover, participants' average daily sodium intake was  $1620.11 \pm 1129.780$  mg and increased significantly by increasing energy intake ( $p < 0.05$ ) (**Table 3**). In Indonesia, the recommended dietary allowances (RDA) energy for children aged 8 to 12 is 1650 kcal to 2000 kcal, while RDA sodium is 1000 mg to 1400 mg (24). The excessive energy adequacy level might be related to the portion size and energy density of the snacks consumed (25, 26). The increased consumption of ultra-processed snack foods and the increased consumption of high-energy, nutrient-poor foods (27). Furthermore, a study in the UK revealed that consumption of ultra-processed foods significantly increased the dietary content of carbohydrates, free sugars, fats, and sodium, while protein, fiber, and potassium decreased (28). The study's findings indicate that the increase in energy and sodium intake across energy adequacy levels is most likely due to increased consumption of ultra-processed foods.

**Table 4** shows contradiction to expectation. This study did not find an association between nutritional status and sodium consumption ( $p > 0.05$ ). This result accords with earlier observations in Malaysia, which showed that obese participants were less likely to consume a high-sodium diet (29). The explanation for these is unclear and differs from prior findings (30). Even though 24 hour recalls appear to be more accurate at reporting total intakes than food frequency questionnaires (FFQ), underreporting of dietary intakes in overweight and obese individuals may contribute to this inconsistency (31, 32).

**Table 3. Energy and sodium intake based on energy adequacy level**

Energy Adequacy Level	n (%)	Energy (kcal)	Sodium Intake (mg)
Severe deficiency	19 (16.5)	1428.4±1655.1	1124.8±126.5
Moderate deficiency	3 (2.6)	1548.0±150.7	827.8±230.9
Mild deficiency	13 (11.3)	1803.4±474.6	1261.6±704.22
Normal	22 (19.1)	2105.6±320.0	1616.3±1141.04
Excessive	58 (50.4)	3154.9±596.1	1905.2±1125.0
<i>p-trend</i>		0.000	0.010

**Table 4. Sodium intake of participants according to nutritional status**

Nutritional Status	Sodium Intake (mg)	p-value
Severely thinness	1654.00 ± 885.30	0.508
Thinness	1962.09 ± 979.75	
Normal	1557.49 ± 1137.26	
Overweight	1963.09 ± 1294.15	
Obese	1226.00 ± 880.73	

While snacking behavior has remained focused on energy intake as the primary cause of overweight and obesity, sodium consumption has also been implicated in the increase in noncommunicable diseases. A study conducted in the United States of America among children and adolescents aged 8 to 18 years revealed a positive correlation between sodium consumption and the risk of developing pre- and hypertension, particularly in those who are overweight or obese (33). In addition, WHO discovered a decrease in resting systolic and diastolic blood pressure as a result of decreased sodium intake in a systematic review and meta-analysis study (5). Even though the number of studies examining the effect of sodium restriction on children is limited, the results of sodium intake studies conducted in adulthood may reflect the potential adverse effect, as renal function development occurs during early childhood.

This study has limitations, including the fact that it relied on cross-sectional analysis to identify associations but not causation. The convenience sample may not be generalizable to the entire population, and a small sample size reduces the statistical power of the analysis. Self-reporting was used to evaluate food recall, yet we did not directly quantify consumption, which may have underestimated consumption. Besides these limitations, the current study is beneficial in providing information on sodium intake and nutritional status caused by snacking behavior in children. Further research is needed to determine the effect of excessive sodium consumption on children's health and the recommended daily sodium intake for children.

## CONCLUSIONS AND RECOMMENDATIONS

Snack consumption is not associated with the nutritional status of school children, but it is associated with daily sodium intake. Thin children consume more snacks and less meal compared to normal. Although thin children have adequate energy level, the higher sodium intake may lead them to health problems. It is essential to consider sodium intake in children in order to prevent the development of degenerative diseases in adulthood. Schools ideally can provide students and parents the comprehensive nutrition education that may influence student's eating habit.

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