



Short Communication

Dietary intake and weight status of urban Thai preadolescents in the context of food environment

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ABSTRACT

Little attention has been devoted to the importance of understanding the association between dietary intake and childhood obesity in Thailand. This study aimed to explore food types affecting the weight status of preadolescents in urban settings, where obesity is remarkably prevalent. This study was conducted in 2015–2016 and assessed the dietary intake of 263 children aged 10–12 years from Bangkok Metropolitan Regions through three- nonconsecutive-day 24 h recall. Lifestyle and sociodemographic information was obtained using questionnaires. Participants were classified into non-obese and overweight/obese groups based on the WHO child growth standard curve. Foods were categorized into 13 groups based on Thailand's dietary guidelines and food environment context regarding two eating occasions (main and between meals) of children, which resulted in the newly classified “street-side snacks”. Data were examined using analysis of covariance and multiple linear regression analysis. After adjusting for sex and energy misreporting, overweight/obese participants had higher energy and macronutrient intake and consumed more cereal grains, meat/fish, flavored milk, and sugar-sweetened beverages during main meals and street-side snacks and confectioneries during between meals than non-obese participants. The consumption of street-side snacks had the highest beta coefficient on BMI z-scores among the food types in the model, adjusted further for energy intakes. Street-side snacks may be an important predictor of obesity in Thai children. A prospective investigation of the impact of accessibility and availability of this food item is needed.

1. Introduction

The prevalence of overweight and obesity is growing rapidly among the children in Thailand (Chavasit et al., 2013). According to Thailand's National Health and Examination Survey, the prevalence of overweight/obesity among children and preadolescents aged 6–14 years rose from approximately 5.4% to 9.7% between 2003 and 2008 based on the weight-for-height percentile provided in the Thai growth reference. Additionally, the urban–rural differences on this issue are striking, and the highest prevalence of both overweight and obesity was found in Bangkok (Mo-suwan, 2010). The prevalence of either overweight or obesity was even higher when the weight status was assessed based on BMI-for-age z-scores (BAZ) provided in the World Health Organization (WHO) growth reference charts, which showed prevalence rates of 24.2% and 18.2% in the urban and rural areas, respectively (Rojroongwasinkul et al., 2013).

Along with the continuing economic growth, the food environment

and lifestyle have also changed as a consequence of rising income. This situation is likely to happen in many low-to-middle-income countries, including Thailand (Popkin et al., 2012). An increase in food access and availability has been accompanied by changes in diet composition (Herforth and Ahmed, 2015). Given such environment, the Thais are currently undergoing nutritional transition, regardless of age and sex (Kosulwat, 2002). Preadolescence is a life period where an individual is easily influenced by the surrounding and relatively easy access to less healthy diet available in the school neighborhood food environment.

To our knowledge, no study to date has addressed the role of diet in the etiology of childhood obesity in Thailand. In particular, comprehensive scientific evidences that demonstrate the effect of food type on weight status are lacking. Determining the food group consumption patterns can provide us with information on the food types that are related to obesity, which could be important in planning the dietary guidelines specific for school-aged children and developing effective nutritional education program.

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Taken together, remarkable changes in food environment are likely to occur in urbanized areas. Therefore, this study aimed to explore the food types that can contribute to an increased BAZ of an urban Thai preadolescent sample, with a focus on the food types consumed during different eating occasions: main and between meals.

2. Methods

2.1. Study design and measurement

This cross-sectional pilot study was conducted in a convenience sample of 294 grade 5 and 6 school-aged children (10–12 years old) in August–September 2015 and September 2016 within the six public schools of Bangkok Metropolitan Regions in Thailand. The height, weight, and birth date of the participants were collected from the school records, which was considered as a physical examination record that was completed within the past one month prior to the performance of the research, and used to calculate BAZ using the WHO AnthroPlus (WHO AnthroPlus for personal computers Manual, 2009). BAZ was classified into two categories based on the WHO child growth standard curve: overweight/obese ($> +1$ BAZ) and non-obese (between -3 and $+1$ BAZ). The exclusion criteria were as follows: incomplete three-day dietary assessment, age ≥ 13 years, failure to return the questionnaire on sociodemographic parameters, and < -3 BAZ. The final sample size included 263 children. The Human Research Ethics Committee of Kagawa Nutrition University and Ethics Committee of Thailand's Department of Health approved the study protocol. Informed consent was obtained from the parents and each child prior to their participation in the study.

The parents or caregivers of each child were asked to complete a short questionnaire prior to the interviews to obtain information on the caregiver and household characteristics.

The food consumption data of each child were collected through three-nonconsecutive-day semi-weighted, interactive 24 h dietary recall (Gibson and Ferguson, 2008) by trained staff. The interviews were conducted in the school within a two-week period.

Each child was asked to list all the foods and drinks they have consumed for 24 h using household measures with the corresponding timing. To obtain as much detail as possible regarding the portion sizes of the foods consumed, a three-dimensional food model was used during the interviews.

The food consumption data were categorized based on Thailand's food-based dietary guidelines and school-aged children's eating context, in which sauces and condiments were not included. The classification system is initially developed and described as follows.

We first categorized the foods based on eating occasion: main and between meals (see Supplementary 1). Foods eaten during the main meal time period were divided into two main groups: “foods recommended on Thailand's food-based dietary guidelines” and “others.” The former were disaggregated based on the main ingredients and then designated into each main food group, which included cereal grains, fruits, vegetables, meat/fish, eggs, cooking fats and oils, and unflavored milk. The latter included convenience foods, packaged snacks, confectioneries, sugar-sweetened beverages (SSB), and flavored milk (see Supplementary 2).

Foods consumed in between the main meals or those that are not self-defined as regular meal were categorized as between meals, which included street-side and packaged snacks, fruits, confectioneries, unflavored and flavored milk, and SSB. “Street-side snacks” is defined as a light meal, local mixed dish, or local/Western fast food that is mostly sold by street-side vendors and road-side shop and does not have food/nutritional label (see Supplementary 2).

This proposed classification system was approved by the nutrition experts from the Bureau of Nutrition, Department of Health, and Ministry of Public Health prior to data analysis.

The total energy intake and percent energy from macronutrients

and micronutrients were assessed using INMUCAL-Nutrients V.3 (Institute of Nutrition, Mahidol University, Thailand) based on Thai food composition tables. All entries were checked for accuracy by a second technician.

To identify inaccurate energy intake reports, the ratio of reported energy intake (rEI) to basal metabolic rate (BMR) was calculated to determine whether rEI was consistent with energy requirement. The BMR was estimated using the age- and sex-specific Schofield's equations (Schofield, 1985).

Under- and over-reporting were detected using the upper and lower cutoff limits of the 95% confidence level between rEI and BMR and physical activity level (PAL), which were determined using the Goldberg equation (Goldberg et al., 1991).

2.2. Statistical analysis

The descriptive data were presented as means with standard deviation or frequency distribution using Student's *t*-test or the chi-square test. The total energy intake and nutrients in each food group were checked for normality using skewed distribution. Analysis of covariance was performed to determine the differences in dietary intake between the two groups after controlling for sex and rEI–BMR ratio because these variables were found to contribute to the differences in weight status. Multiple linear regression analysis was used to identify the food groups that could serve as predictors of BAZ. Subsequently, two models were fitted: model 1, which was adjusted for sex and rEI–BMR ratio, and model 2, which was additionally adjusted for energy intake. All analyses were performed using SPSS, version 23 (SPSS Inc., Chicago, IL, USA), and $p < 0.05$ was considered statistically significant.

3. Results

Participants who were overweight/obese account for 33.5% of the 263 children included in the study. Furthermore, overweight/obese participants were more likely to be boys (51.1%) and to misreport their diets (43.2%) than non-obese participants.

After adjusting for energy intake misreporting, participants who were overweight/obese had higher daily energy intake and macronutrient consumption than those who were non-obese. The percentage energy from carbohydrate, protein, and fat did not differ between groups. Additionally, all the selected micronutrient intakes of overweight/obese participants were higher than those of non-obese participants (Table 1).

Overweight/obese participants reported significantly higher consumption of cereal grains, meat/fish, flavored milk, and SSB during main meals than non-obese participants. Furthermore, the former also consumed more street-side snacks and fewer confectioneries during between meals than the latter. No difference in the energy intake during the main and between meals was observed.

In the regression model adjusted for rEI–BMR ratio and sex, main meals and between meal foods were found to be positively associated with BAZ. Furthermore, street-side snacks had the most significant effect on BMI z-scores ($\beta = 0.390$, $p < 0.001$), even after controlling further for energy intake ($\beta = 0.094$, $p = 0.018$) (Table 2).

4. Discussion

This study is the first to explore the food types that contributed to the weight status of urban Thai preadolescents, especially by clarifying the relatively precise classification of food eaten between meals. Overweight/obese preadolescents consumed more cereal grains, meat/fish, flavored milk, and SSB during main meals and more street-side snacks and confectioneries during between meals than non-obese participants. With our novel food group classification system clarifying the snack types, we primarily demonstrated that street-side snack consumption was associated with increased BAZ. This approach contributes

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