Eating out of home in Vietnamese adolescents: socioeconomic factors and dietary associations1–4

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ABSTRACT

Background: Out-of-home (OH) eating in developed countries is associated with suboptimal dietary intakes, but evidence is scarce on the situation in developing countries.

Objective: The objective of this study was to determine the nutritional contribution of OH eating and related socioeconomic determinants in Vietnamese adolescents.

Design: A 24-h recall was used to collect food intake data in a cross-sectional study of 1172 adolescents living in urban and rural areas. Multilevel analysis compared the mean daily intakes of energy, energy density, energy from fat, food groups, vitamin A, iron, and zinc in low, middle, and high consumers of OH food. Socioeconomic associations of OH eating were analyzed in a subsample of 870 adolescents.

Results: OH foods contributed 42% of fruit and vegetables, 23% of sodium, 21% of energy, 21% of vitamin A, 21% of iron, and 21% of zinc consumed per day. OH eating was negatively associated with total energy intake and energy density and positively associated with dietary diversity, energy contribution from fat, and consumption of sugar products. In rural areas, OH eating was positively associated with iron, fruit, meat, poultry, and offal intake. Female sex (P < 0.001), residence in urban areas (P < 0.001), and amount of pocket money (P < 0.001) were positively associated with consumption of OH foods.

Conclusions: OH eating added a number of desirable foods and nutrients but was also associated with higher consumption of energy from fat and sugar products. Independent of household wealth and locality, pocket money and sex are important determinants of OH eating. Am J Clin Nutr 2009;90:1648–55.

INTRODUCTION

As low- and middle-income countries (LMICs) such as Vietnam experience rapid development, there is a concurrent change in dietary patterns. Although malnutrition remains the predominant nutritional concern in Vietnam, recent studies have documented that diet-related chronic diseases are emerging, particularly in urban areas of the country (1–3). Studying the food intake and dietary habits of adolescents is important because adolescent nutrition status is an acknowledged predictor of adult nutrition status (4), and adolescence offers an important window of opportunity to prevent risk factors for diet-related non-communicable diseases, which can track later into adulthood (5).

Epidemiologic studies, conducted mainly in developed countries, have linked substantial consumption of foods prepared out of home (OH) with higher energy intake and increased body mass index (BMI) in those that consume these foods (6–10). Frequent OH eating has been associated with lower intakes of fruit and vegetables (7, 11) and a lower number of micronutrients including calcium and iron (12–14). Adamson et al (15) showed that food consumed OH by adolescents had a lower nutrient (protein, calcium, iron, and vitamin A) density but a higher content of fat and sugars compared with food consumed at home in the United Kingdom. In Mexico City, foods consumed in schools were of a lower nutritional quality compared with home-prepared foods (16). Foods obtained from school were mainly potato chips, soft drinks, fresh fruit, cheese tortillas, and sandwiches or processed bakery products.

Urbanization is a major driver of the consumption of OH foods, particularly through the availability of street foods (17, 18). Studies have reported energy contribution from street foods that ranged from 13% to 40% in schoolchildren in urban Kenya (19) and Benin (20). Studies in adults living in urban areas of LMICs reported similar figures (19, 21, 22). Substantial consumption of OH foods is not restricted to urban areas. Gewa et al (23) showed that OH foods contributed to 13–19% of the daily energy intake, depending on the season, in rural Kenya. Despite the vast dietary importance of OH foods in LMICs, few studies have assessed their nutritional importance (24). The extent to which the nutrition transition is mediated by socioeconomic status needs clarification. Although socioeconomic differences in dietary quality have been documented (25), the specific socioeconomic factors driving dietary changes in LMIC are poorly documented (26). The primary objectives of this study were to evaluate the contribution from OH foods in the diet of Viet-
nese adolescents attending school and to examine the relation between eating OH and the daily food intake of consumers. A secondary objective was to assess the socioeconomic determinants of eating OH in adolescents in rural and urban areas.

SUBJECTS AND METHODS

Sample

Data were collected from a cross-sectional survey conducted in Hanam Province and Hanoi city in Vietnam. A sample size of 244 subjects per group (rural and urban) was needed to detect a difference of 0.25 SD of dietary intake with a power of 80% and precision of 95%. A total sample size of 976 adolescents was calculated after accounting for a design effect of 2. Sample size calculations were carried out by using GPower (27). We intended to measure all children in a classroom. Eight schools were included in the present study. The number of schools was estimated after determining the average number of children per classroom and the average number of classrooms per school. To avoid large sampling heterogeneity, schools with ongoing health interventions were not considered. Four schools in rural areas and 4 schools in urban areas were conveniently selected as clusters. In each school, all grade 11 students were invited to participate. We aimed to study middle adolescents (aged 15–17 y) because, at this age, Vietnamese children start to receive pocket money, which they could use to purchase OH foods. There were no exclusion criteria for the children. The methods and objectives of the study were explained to the adolescents, and their written consent and that of their parents were obtained. The study protocol was approved by the Medical Research Ethics Committee of the National Institute of Nutrition of Vietnam. The initial recruitment date was 23 November 2006.

Anthropometric data

Weight was recorded to the nearest 100 g by using a digital scale (Seca Uniscale, Hamburg, Germany). Students wore light clothing and no shoes. Height was measured to the nearest 1 mm by using a portable fixed-base stadiometer (CMS Weighing Equipment, London, United Kingdom). All measurements were done in duplicate by the school’s nurse and recorded by the researchers. The average of both registrations was used for analysis. Date of birth was obtained from the school medical records. BMI categories for overweight, obesity were determined by using age- and sex-specific cutoffs from Cole et al (28, 29).

Food intake data

Food intake was assessed by using one 24-h recall. This method does not provide estimates of within-subject variation of food intake. The usual intake of nutrients by individuals cannot be calculated nor can food intake data be compared with recommendations to estimate the proportion at risk of inadequate intake. However, when conducted with a large sample on different days in the week, registering one day is appropriate for estimating mean intakes on a group level (30, 31). Recall days were randomly spread over the week.

Trained and experienced local dietitians were used to record food intake. Specific attention was given to the accurate estimation of the quantity and recipes of OH foods. For the OH foods, the interviewers asked the respondent the name, price, and place of preparation of the meals consumed by the participants. The interviewers later returned to the place of preparation and recorded the specific recipe of the meal consumed, weighed the quantity of each ingredient used, estimated the total portion size of the meal, and estimated an equivalent price. For other foods (ie, those prepared at home), the respondents were asked to estimate the quantity consumed by using standard measuring units that were familiar to them. The interviewers also registered the time of day at which the foods were consumed. The Vietnamese food composition table was used for nutrient composition of all foods (32). Food intake data were entered and processed by using Microsoft Access (Microsoft Corporation, Redmond, WA).

In the present study, OH foods are foods prepared outside the home, regardless of where they are consumed. We use place of preparation as the criterion to define OH foods on the premise that the composition of food consumed is essentially determined by the place of preparation and not by the place of consumption. Food and beverages consumed were registered in the following categories: “food prepared and consumed at home,” “food prepared OH and eaten at home” (ie, food prepared outside by commercial vendors but consumed at home), “food prepared and eaten at school,” “food prepared and eaten OH in places other than school,” and “other.”

Dietary quality was assessed through a Dietary Diversity Score, which represented the number of different food groups consumed. The Dietary Diversity Score is positively associated with dietary quality and nutritional adequacy (33–36). Following the approach of Kennedy et al (35), only food groups for which >10 g was consumed were considered for the Dietary Diversity Score. Following the food group classification used in Vietnam, foods consumed were allocated to the following food groups: cereals, roots/tubers, vegetables, fruit, meat/poultry/offal, eggs/milk/milk products, fish/seafood, seeds/legumes/nuts, oils/fats, sugar/sweets/soft drinks, and miscellaneous (including spices and alcohol).

We assessed the mean intakes of food and nutrients among low, middle, and high consumers of OH food. Categories of OH eating were defined by using tertiles of the contribution of energy from OH foods on a daily basis: “low OH” as the first tertile, “medium OH” as the middle tertile, and “high OH” as the third tertile.

Physical activity

The participants completed a translated version of the International Physical Activity Questionnaire, which assessed physical activity during a habitual week (37). The instrument was previously validated for use in classifying Vietnamese rural and urban adolescents in categories of physical activity (38).

Socioeconomic status

Participant socioeconomic information was collected during a second survey from a subsample of the population. Some of the children in the food intake study were not available during this second survey and thus did not provide socioeconomic information. Socioeconomic status was measured by using a self-reported questionnaire. To estimate the household economic status, a comprehensive index that incorporated household assets and type of house as proxies for accumulated household wealth.
was developed. The main household assets were predetermined by the participants during focus-group discussion. Participants were asked to list the number, make, and type (new or second hand) of the following household assets: air conditioning, refrigerator, car, television, motorcycles (both in the household and personal ones), and computer or laptops. The type of house (concrete house, 4-level home, temporary housing, or other) was specified together with its location (big street, small street, new residential area, village, or other). All household assets were converted to their financial values and summed to produce a total value. To estimate the purchasing power of the adolescents, the participants recorded the amount of pocket money that they received during the week. Both the pocket money and household accumulated wealth were further categorized into “better off” (highest tertile) and “normal” (2 lowest tertiles). The categorization was done a priori and separately for rural and urban areas.

The education level of both parents was recorded as well. The options to indicate the education level of the parents were as follows: “illiterate,” “primary (grades 1–5),” “junior secondary (grades 6–9),” “senior secondary (grades 10–12),” “college, university” or “higher degree,” and “don’t know.” The education level of the parents was classified into 2 categories: “senior secondary or lower” and “college, university, or higher education.”

A dichotomous variable, “urban/rural,” was used for location. We classified students who live in Hanoi as “urban” and those who live in Hanam province as “rural.”

Statistical analysis

Statistical analysis was done by using STATA (IC, version 10; StataCorp, College Station, TX). A Box-Cox transformation was applied to nonnormally distributed data before analysis. To account for the clustering, differences in dietary intake between consumers of OH foods were tested through multilevel regression (XTREG command in STATA 10.0) (39, 40). Level 1 was “students,” and level 2 was “school.” We did not account for the intermediate level of “classroom” because a preliminary analysis showed that the intraclass correlation was negligible at that level. The models first compared dietary intake between categories of OH consumers stratified by location because we specifically aimed to explore dietary differences in rural and urban areas in our survey design. A second multilevel model tested how socioeconomic variables related to energy from OH foods. This model included variables yielding a $P < 0.2$ in bivariate analysis. Interaction terms between location/pocket money and pocket money/household wealth status were also inserted. A stepwise backward procedure was then followed with removal of variables, including interaction terms, when the likelihood-ratio test yielded a $P > 0.05$. We also analyzed the associations of the socioeconomic and overall dietary intake by using this multilevel approach. All tests were 2-sided, and all $P$ values were adjusted for multiple testing by using a Bonferroni correction.

RESULTS

Description of participants

All children agreed to participate in the food intake study and provided data. A total of 1172 participants provided data; 57.4% of the participants were female. The mean (±SEM) age, weight, height, and BMI (in kg/m$^2$) of the children were 16.4 ± 0.03 y, 49.2 ± 0.87 kg, 159.0 ± 0.56 cm, and 19.4 ± 0.21, respectively. In the sample, 24.9% of the adolescents were underweight, 3.8% were overweight, and 0.4% were obese. The prevalence of underweight was higher in rural areas compared with urban areas (27.4% compared with 22.3%), although it did not reach statistical significance ($P = 0.113$). In general, 30.1% of the adolescents were categorized as having a low physical activity level and only 4.6% as highly active. Adolescent overweight and low physical activity was associated with living in urban areas ($P < 0.001$ and $P = 0.03$, respectively).

Average daily intakes

Urban adolescents consumed more fruit and vegetables, vitamin A, iron, zinc, and energy from fat and ate more food groups when compared with their rural peers (Table 1). Adolescents in rural areas had a daily food intake with a higher energy density compared with those in urban areas. The energy supply from fat in the diet was generally very low.

OH eating and dietary intake

Adolescents with a higher energy intake from OH foods consumed more food groups and had a higher percentage of total energy from fat (Table 2). Their total energy intake and the energy density of their daily diet, however, was lower compared with low consumers of OH foods. Consumption of OH foods in rural areas was also positively associated with the intake of iron and vitamin A (marginally insignificant). The intraclass correlation coefficient of energy from OH foods in schools was 0.04 and 0.006 in rural and urban areas, respectively.

Dietary contributions of OH foods

The contribution of OH foods to the average daily intake of energy, fruit and vegetables, sodium, vitamin A, iron, and zinc in the overall diet was consistently higher in the adolescents from urban areas (Table 3).

The category of OH foods that contributed most to daily energy intake was “food prepared OH but consumed at home.” On a daily basis, these foods provided 14.3% of the energy intake (8.7% in rural and 19.6% in urban areas). The “foods prepared and consumed in schools” and “foods prepared and consumed OH in places other than schools” contributed an additional 4.9% and 25.4% of the daily energy intake, respectively. These contributions were similar in rural and urban areas (not shown). Foods from other sources of preparation provided marginal sources of energy (0.3% of energy from all OH foods).

Breakfast, lunch, dinner, and snacks contributed 15.6%, 38.9%, 38.5%, and 7.0%, respectively, of the energy consumed in a day. This distribution was similar in rural and urban areas (not shown). OH foods contributed 56.9%, 8.5%, 8.3%, and 72.5% of the energy consumed during breakfast, lunch, dinner, and snacks, respectively. In urban areas, OH foods contributed 81.1% and 78.2% of the energy consumed during breakfast and snacks; in rural areas, this was only 34.3% and 55.0%.
TABLE 1
Daily dietary intakes of Vietnamese adolescents living in rural or urban areas

|                     | All (n = 1172) | Rural (n = 588) | Urban (n = 584) | P
|---------------------|----------------|----------------|----------------|---
| Energy intake (kcal) | 2405.8 ± 57.7  | 2328.1 ± 75.6  | 2484.1 ± 75.6  | 1.0
| Energy density (kcal/100 g) | 195.7 ± 8.5  | 216.4 ± 5.6  | 174.8 ± 5.6  | <0.001
| DDS<sup>1</sup> | 6.7 ± 0.2  | 6.2 ± 0.2  | 7.2 ± 0.2  | <0.001
| Energy from fat (%) | 17.2 ± 0.9  | 15.1 ± 0.8  | 19.4 ± 0.8  | <0.001
| Fruit and vegetables (g) | 421.2 ± 45.6  | 320.0 ± 38.4  | 523.0 ± 38.4  | <0.001
| Sodium (mg) | 1572.2 ± 86.3  | 1643.2 ± 126.8  | 1500.7 ± 124.8  | 1.0
| Vitamin A (RE) | 881.2 ± 97.0  | 662.4 ± 78.1  | 1101.4 ± 78.1  | <0.001
| Iron (mg) | 16.2 ± 0.9  | 14.3 ± 0.9  | 18.1 ± 0.9  | <0.001
| Zinc (mg) | 10.6 ± 0.5  | 9.6 ± 0.4  | 11.6 ± 0.4  | <0.001

<sup>1</sup> All values are means ± SEMs, with adjustment for school. DDS, Dietary Diversity Score; RE, retinol equivalents.
<sup>2</sup> Calculated by using multilevel analysis with school as the fixed effect in rural compared with urban areas. Bonferroni-corrected P values were tabulated. P values >1 were truncated to 1.0.
<sup>3</sup> Expressed as the number of food groups of which >10 g was consumed.

Food groups consumed

Overall, the consumption of OH food was positively associated with the consumption of sugar, sweets, and soft drinks (Table 4). In rural areas, consumption of OH foods was also positively associated with the consumption of fruit, meat, poultry, and offal.

We showed distinct differences in the type of foods prepared at home and OH (Table 5). Fruit, sandwiches, and soups were the most frequently consumed OH foods. Meals prepared at home were predominantly fried or boiled preparations, which are commonly served as dishes. Although foods prepared at home were similar in rural and urban areas, the most frequently OH foods consumed varied by location. In rural areas, sweet desserts (n = 172/1709, 10%), fried meat (n = 141/1709, 8%), bread with liver pâté (n = 134/1709, 8%), rice doughnut (n = 98/1709, 6%), and fruit (n = 741709, 4%) were the most common. In urban areas, adolescents most frequently consumed fruit (n = 657/4564, 14%), bread with liver pâté (n = 232/4564, 5%), beef noodle soup (n = 223/4564, 5%), dessert (n = 202/4564, 4%), and bread with salted shredded meat (n = 198/4564, 4%) as OH food.

Socioeconomic status

Of the initial sample, 74% (n = 870) of the children completed the socioeconomic questionnaire. Children who provided socioeconomic information did not differ from those who did not provide information on total energy intake, mean BMI, and share of energy from OH foods in rural (P = 0.13, P = 0.99, P = 0.80, respectively) or urban areas (P = 0.13, P = 0.67, P = 0.43, respectively).

The availability of pocket money was associated with an increase of 4.7% in energy from OH foods, and this effect was independent of location and sex (Table 6). Pocket money was associated with consuming >10 g meat, poultry, or offal (β = 6.7%, P = 0.05) but not with the other food groups or nutritional

TABLE 2
Intakes of energy, sodium, vitamin A, iron, and zinc by categories of out-of-home (OH) eating among Vietnamese adolescents

<table>
<thead>
<tr>
<th></th>
<th>Low OH (n = 196)</th>
<th>Medium OH (n = 195)</th>
<th>High OH (n = 195)</th>
<th>P for interaction</th>
<th>P for trend&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy from OH food (%)</td>
<td>0.1 ± 0.01</td>
<td>7.0 ± 0.01</td>
<td>27.6 ± 0.04</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Total energy intake (kcal)</td>
<td>2323.9 ± 57.2</td>
<td>2634.6 ± 116.6</td>
<td>2522.0 ± 107.6</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Energy density (kcal/100 g)</td>
<td>235.9 ± 2.9</td>
<td>187.3 ± 2.8</td>
<td>191.1 ± 1.8</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>DDS&lt;sup&gt;2,3&lt;/sup&gt;</td>
<td>5.7 ± 0.1</td>
<td>7.0 ± 0.1</td>
<td>6.4 ± 0.1</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Energy from fat (%)</td>
<td>13.8 ± 0.5</td>
<td>18.3 ± 0.7</td>
<td>14.8 ± 0.3</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Sodium (mg)&lt;sup&gt;3&lt;/sup&gt;</td>
<td>1616.1 ± 108.5</td>
<td>1587.8 ± 91.6</td>
<td>1777.4 ± 68.6</td>
<td>1536.0 ± 108.5</td>
<td>1343.7 ± 91.4</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Vitamin A (RE)&lt;sup&gt;3&lt;/sup&gt;</td>
<td>559.4 ± 78.8</td>
<td>1109.0 ± 70.8</td>
<td>691.6 ± 96.6</td>
<td>756.3 ± 78.3</td>
<td>1051.5 ± 70.6</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Iron (mg)&lt;sup&gt;3&lt;/sup&gt;</td>
<td>13.5 ± 0.5</td>
<td>19.2 ± 1.1</td>
<td>14.4 ± 0.3</td>
<td>15.0 ± 0.5</td>
<td>16.3 ± 1.1</td>
<td>0.096</td>
<td>1.0</td>
</tr>
<tr>
<td>Zinc (mg)&lt;sup&gt;3&lt;/sup&gt;</td>
<td>9.4 ± 0.2</td>
<td>12.4 ± 0.5</td>
<td>9.7 ± 0.2</td>
<td>9.7 ± 0.2</td>
<td>10.5 ± 0.5</td>
<td>0.8</td>
<td>0.112</td>
</tr>
</tbody>
</table>

<sup>1</sup> All values are means ± SEMs, with adjustment for school. OH was categorized as “low OH” in the first tertile, as “medium OH” in the second tertile, and as “high OH” in the third tertile of contribution of energy from OH foods on a daily basis. DDS, Dietary Diversity Score; RE, retinol equivalents. Multilevel analysis used school as the fixed effect. Low OH was the reference category.
<sup>2</sup> Calculated by using multilevel analysis with school as the fixed effect in rural compared with urban areas. P values were Bonferroni adjusted. P values >1 were truncated to 1.0.
<sup>3</sup> Not tested because categorization was performed by using energy contribution from OH food.
<sup>4</sup> Expressed as number of food groups for which >10 g was consumed.
<sup>5</sup> Adjusted for total energy intake in the model as described by Willet (30).
variables. The importance of the pocket money as a socioeconomic determinant of OH eating was more pronounced in rural ($\beta = 5.8\%$, $P$ for interaction < 0.001) compared with urban areas ($\beta = 3.4\%$, $P = 0.073$; $P$ for interaction = 0.087).

Socioeconomic variables and their association with daily dietary intake by Vietnamese adolescents are shown in Table S1 and Table S2 under “Supplemental data” in the online issue. Apart from having pocket money, being male and living in urban areas were other influential factors of OH food consumption. Living in urban areas, independent of wealth status and sex, was negatively associated with energy density ($\beta = -34.6$ kcal/100 g, $P < 0.001$) and positively associated with energy from fat ($\beta = 4.2\%$, $P < 0.001$), fruit and vegetables ($\beta = 173.4$ g, $P < 0.001$), vitamin A ($\beta = 324.5$ RE, $P = 0.05$) and iron ($\beta = 3.4$ mg, $P < 0.001$) and with consuming > 10 g of roots and tubers ($\beta = 9.2\%$, $P < 0.001$), fruit ($\beta = 28.1\%$, $P < 0.001$), meat, poultry, or offal ($\beta = 15.7\%$, $P < 0.001$) and eggs, milk, or milk products ($\beta = 30.5\%$, $P < 0.001$).

There were differential dietary intakes between adolescent males and females, and this varied according to location. Compared with adolescent males, adolescent females in rural areas had a higher energy intake from fat in rural areas ($P$ for interaction = 0.022) and were likely to consume > 10 g of roots and tubers ($P$ for interaction = 0.140). In urban areas, adolescent males had a higher energy density and a higher intake of fruit, vegetables, and sodium and were more likely to consume > 10 g of oils and fats ($P$ for interaction < 0.001).

**DISCUSSION**

OH foods are important in the diet of Vietnamese adolescents attending school. Contrary to what we expected, substantial OH eating in rural areas was associated with a higher intake of vitamin A and iron. Deficiencies in vitamin A and iron are of great public health concern in many LMIC (5). In rural areas, eating OH provided additional food groups, in particular meat, poultry, offal, and fruit, which positively affected the intake of micronutrients. From previous studies (6, 7, 9, 10), we expected OH eating to be positively associated with higher energy intake and energy density, but the opposite was observed here. The importance of the fruit and soups in the OH foods is an important factor contributing to this. Interestingly, an increased consumption of OH foods was also paralleled by an increased supply of energy from fat on a daily basis. Only the highest

**TABLE 3**

| Contribution of out-of-home foods to daily food and nutrient intake in Vietnamese adolescents$^1$ |
|-----------------------------------------|-----------------|-----------------|-----------------|-----------------|
| All (n = 1172) | Rural (n = 588) | Urban (n = 584) | $P^2$ |
| Energy (%) | 21.1 ± 3.7 | 11.8 ± 1.8 | 30.3 ± 1.8 | <0.001 |
| Fruit and vegetables (%) | 41.8 ± 5.3 | 29.5 ± 4.0 | 54.1 ± 4.0 | <0.001 |
| Sodium (%) | 22.6 ± 4.2 | 12.1 ± 2.1 | 33.1 ± 2.1 | 0.084 |
| Vitamin A (%) | 20.9 ± 4.5 | 11.7 ± 2.6 | 30.1 ± 2.6 | <0.001 |
| Iron (%) | 21.0 ± 3.5 | 11.8 ± 1.7 | 30.3 ± 1.7 | <0.001 |
| Zinc (%) | 20.7 ± 3.3 | 11.3 ± 1.4 | 30.1 ± 1.4 | <0.001 |

$^1$ All values are means ± SEMs, with adjustment for school.

$^2$ Calculated by using multilevel analysis with school as the fixed effect in rural compared with urban areas. Bonferroni-corrected $P$ values were tabulated.

**TABLE 4**

| Vietnamese adolescents who consumed > 10 g of different food groups per category of out-of-home (OH) eating$^1$ |
|---------------------------------------------------------------|-----------------|-----------------|-----------------|-----------------|
| | Low OH | Medium OH | High OH | $P$ for trend |
| | Rural (n = 196) | Urban (n = 194) | Rural (n = 196) | Urban (n = 195) | Rural (n = 196) | Urban (n = 195) | $P$ for interaction$^2$ | Rural | Urban |
| Cereals$^3$ | | | | | | | | |
| Root and tubers | 100 | 100 | 100 | 100 | 100 | 100 | 100 | — | — |
| Vegetables | 94 ± 30 | 99 ± 65 | 96 ± 19 | 100 ± 33 | 95 ± 31 | 94 ± 31 | 1.0 | 1.0 | 1.0 |
| Fruit | 29 ± 22 | 79 ± 21 | 70 ± 19 | 88 ± 17 | 67 ± 22 | 85 ± 23 | <0.001 | <0.001 | 1.0 |
| Meat, poultry, and offal | 67 ± 15 | 99 ± 66 | 88 ± 12 | 99 ± 44 | 89 ± 22 | 97 ± 51 | <0.001 | <0.001 | 1.0 |
| Eggs, milk, and milk products | 31 ± 30 | 57 ± 15 | 29 ± 28 | 70 ± 11 | 38 ± 30 | 66 ± 15 | 0.390 | 1.0 | 0.570 |
| Fish and seafood | 45 ± 17 | 44 ± 16 | 45 ± 13 | 48 ± 12 | 48 ± 17 | 53 ± 16 | 0.890 | 1.0 | 0.740 |
| Seeds, legumes, and nuts | 30 ± 15 | 37 ± 14 | 30 ± 9 | 41 ± 9 | 37 ± 14 | 41 ± 13 | 0.310 | 1.0 | 1.0 |
| Oils and fat | 63 ± 16 | 63 ± 41 | 68 ± 11 | 66 ± 40 | 68 ± 16 | 53 ± 41 | 1.0 | 1.0 | 1.0 |
| Sugar, sweets, and soft drinks | 4 ± 29 | 34 ± 17 | 10 ± 15 | 51 ± 13 | 21 ± 17 | 53 ± 16 | <0.001 | <0.001 | <0.001 |
| Miscellaneous | 3 ± 34 | 4 ± 35 | 6 ± 25 | 7 ± 22 | 1 ± 44 | 9 ± 27 | 0.270 | 1.0 | 0.410 |

$^1$ All values are means ± SEMs, with adjustment for school. OH was categorized as “low OH” in the first tertile, as “medium OH” in the second tertile, and as “high OH” in the third tertile of contribution of energy from OH foods on a daily basis. Multilevel analysis used school as the fixed effect. Low OH was the reference category. Tabulated $P$ values were Bonferroni corrected. $P$ values > 1 were truncated to 1.0.

$^2$ Interaction term of location (rural/urban) and categories of OH eating.

$^3$ All children in the sample consumed > 10 g of cereals.
tertile of urban OH consumers reached the minimum recommended amount of 20% of energy from fat for Vietnamese adolescents (41). Unfortunately, however, because of the lack of information on fatty acid composition in the food composition tables, we were unable to evaluate the nutritional implications of this trend.

Surprisingly, children from urban areas had a lower-energy-dense diet. Fruit and noodle soups, characterized by their low energy density, were relatively more important as OH foods in urban compared with rural areas. The importance of the fruit and soups in the OH foods also explains why participants consuming a greater proportion of OH foods consumed more energy from fat but had a lower-energy-dense diet.

OH eating occurred mainly during breakfast and for snacks, as also observed by Nago et al (20) in Benin. OH foods were different from foods prepared at home. It has been acknowledged previously how OH foods, mainly street foods, are an important source of traditional foods (42). The findings of this study highlight the importance of valuing traditional foods prepared OH to promote healthy diets, a strategy that has proven to be effective in South Korea (43).

Similar to previous findings (20), we also observed the increased importance of sugar products and soft drinks in high consumers of OH food in both rural and urban areas. Drewnowski and Popkin (44) argued earlier how the nutrition transition and urbanization have triggered increased consumption of animal products, sugars, and dietary diversification. Our findings support this observation and add evidence that OH eating contributes to this trend. Unlike home-prepared foods, OH foods are prepared commercially. Their composition is consequently more likely to reflect the dietary preferences prevailing in its consumers. The increased consumption of sugar and sweet foods observed here may presage changing dietary patterns in Vietnamese adolescents in a rapidly changing society and provide an early nutrition transition context. Monitoring the composition of OH foods is potentially an informative and sentinel indicator in a surveillance program that tracks the dietary intake of adolescents attending schools.

Independent of sex, location, household wealth, and education status of the parents, a key predictor of eating OH was the availability of pocket money. Various studies, predominantly

### TABLE 5

The 5 most popular foods prepared at home and out of home (OH) and their proportion of the total number of meals consumed by Vietnamese adolescents

<table>
<thead>
<tr>
<th>Home meals</th>
<th>n</th>
<th>Percentage of all meals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiled rice with roast meat</td>
<td>2183</td>
<td>15</td>
</tr>
<tr>
<td>Boiled vegetables</td>
<td>663</td>
<td>4</td>
</tr>
<tr>
<td>Stir-fried vegetables with oil</td>
<td>549</td>
<td>4</td>
</tr>
<tr>
<td>Fried meat</td>
<td>480</td>
<td>3</td>
</tr>
<tr>
<td>Fried egg</td>
<td>349</td>
<td>2</td>
</tr>
<tr>
<td>OH meals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fruit</td>
<td>775</td>
<td>12</td>
</tr>
<tr>
<td>Bread with liver pâté and vegetables</td>
<td>503</td>
<td>8</td>
</tr>
<tr>
<td>Sweet desserts</td>
<td>374</td>
<td>6</td>
</tr>
<tr>
<td>Bread with salted and shredded meat</td>
<td>254</td>
<td>4</td>
</tr>
<tr>
<td>Noodle soup with beef</td>
<td>241</td>
<td>4</td>
</tr>
</tbody>
</table>

### TABLE 6

Socioeconomic variables and their association with energy contribution from out-of-home (OH) foods consumed by Vietnamese adolescents

<table>
<thead>
<tr>
<th>Accumulated household wealth$^6$</th>
<th>Energy from OH food$^7$</th>
<th>Crude model$^7$</th>
<th>Adjusted model$^7$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Better off ($n = 392$) compared with normal ($n = 780$; ref)$^7$</td>
<td>$20.3 \pm 4.0$</td>
<td>$2.9$</td>
<td>$0.252$</td>
</tr>
<tr>
<td>Pocket money</td>
<td>$19.8 \pm 3.8$</td>
<td>$5.6$</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Better off ($n = 298$) compared with normal ($n = 874$; ref)$^7$</td>
<td>$16.8 \pm 4.0$</td>
<td>$7.8$</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Sex</td>
<td>$11.9 \pm 1.8$</td>
<td>$18.7$</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Female ($n = 673$) compared with male ($n = 499$; ref)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>$20.7 \pm 2.2$</td>
<td>$0.6$</td>
<td>1.0</td>
</tr>
<tr>
<td>Urban ($n = 584$) compared with rural ($n = 588$; ref)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education of father</td>
<td>$21.4 \pm 2.8$</td>
<td>$0.6$</td>
<td>1.0</td>
</tr>
<tr>
<td>College, university, or higher education ($n = 232$) compared with senior secondary or lower ($n = 519$; ref)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^1$ Values are mean ± SEM estimates of the reference (ref) category as derived from the multilevel model.

$^2$ Calculated by using a multilevel model with school as the fixed effect and with adjustment for household wealth status.

$^3$ Calculated by using a multilevel model with school as the fixed effect, energy from OH foods as the dependent variable, and single socioeconomic variables as the independent variables.

$^4$ Coefficients are expressed as the percentage increase in energy from OH foods.

$^5$ Bonferroni corrected; values >1 were truncated to 1.0.

$^6$ Composite index constructed from the financial value of household assets (air conditioning, refrigerator, car, television, motorcycles, and computer) and the type of house.

$^7$ Better off” indicates the highest tertile and “normal” the 2 lowest tertiles. The categorization was made a priori and was made separately for rural and urban areas.
from developed countries, have shown how household socioeconomic status is associated with dietary quality (25). Our findings did not confirm this association and showed that individual purchasing power is a more powerful predictor compared with household socioeconomic status in adolescents. Pocket money, as a mediator in dietary choices, is acknowledged by various qualitative studies with adolescents (45–48). Our observation indicates that the purchasing power of adolescents should be accounted for when developing interventions to improve the diets of adolescents in Vietnam and provides ground for additional studies of the drivers of eating OH in Vietnamese adolescents.

Schools were not randomly selected, which might limit the external validity of our findings. Because the mean BMI and the prevalence of overweight of our sample corresponds to the available national estimates for Vietnamese adolescents (49) and a 2009 national survey (LNB Khanh, personal communication, 2009), we argue that the potential selection bias is minimal. We did not exclude over- and under-reporters from analysis. Over- and underreporting is calculated by using basal metabolic rate (50). Various studies have questioned the Schofield equations for their use in nonwhite adolescents (51, 52). We identified over- and underreporters (8.5% and 18.4%, respectively) by using the revised Goldberg criteria (31) and repeated the analysis excluding these children. The associations and $P$ values between the nutritional indicators and OH eating did not change (results not shown).

We categorized all foods on the meal level (not on the level of ingredients) with regard to where the meals were prepared and where they were consumed. Using the place of preparation to characterize foods, however, is potentially difficult for foods that are not prepared and consumed raw (eg, fruit and some vegetables). Because these foods might have been misclassified during the interview process, we repeated the analysis after excluding these foods. The only difference observed was that the trend of vitamin A consumption was no longer significant between the different categories of OH foods consumers. Given the overall consistency of these results with our initial analysis, we argue that the systematic bias of misclassification of foods is minimal. Defining what OH foods are, however, remains difficult, and therefore we cannot rule out the possibility of misclassifying some foods in our study.

A striking observation in our study is that OH foods were mainly foods prepared OH but eaten in the home and not food prepared and consumed at school or in the street as expected. Other studies (53–55) and national surveys (10) have used the place of consumption as the criterion for defining OH foods. When using such definition, the foods prepared OH but eaten at home would be classified as “home food.” With our data this would mean that 14% of the daily energy intake (20% in urban areas) is misclassified.

In our sample, participants’ school explained only a small part of the variation in eating OH. In contrast, having pocket money, sex, and living in a rural or an urban area were important predictors. Acknowledging that adolescents rely on OH foods, various organizations have set up school feeding programs. Development of school policies is now advocated by the World Health Organization as an instrument for promoting optimal diets (56). Our findings provide evidence that the entire dietary environment of adolescents and the nutritional quality of what is prepared and offered OH should be considered in this context.

We thank Lieve de Groot for her contributions during the management of the data, Huynh Thi Thanh Tuyen for her help with the Vietnamese foods and socioeconomic information, and Brandy-Joe Milliron for the language assistance.

The authors’ responsibilities were as follows—CL, LNBK, and PK: designed and supervised the study; NCK, NQD, and NDVA: ensured quality of the data and made a substantial contribution to the local implementation of the study; and DR: assisted in the analysis and interpretation of the data. All authors critically reviewed the manuscript. CL and corresponding authors had access to all data at all times and had the final responsibility to submit the manuscript for publication. None of the authors had a conflict of interest.

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